No.

REPORT

OF THE DETAILED DESIGN SURVEY

ON THE MODEL INFRASTRUCTURE IMPROVEMENT WORKS

(VETERINARY PADDOCK)

FOR THE UNIVERSITY OF ZAMBIA

VETERINARY EDUCATION PROJECT

JANUARY, 1986

JAPAN INTERNATIONAL COOPERATION AGENCY

No.

CONTENTS

CHAPTE 1 DISPACH OF THE IMPLEMENTATION SURVEY TEAM

1-1 Objectives of dispach of the Team

Although stock-farming has been traditionally performed in Zambia, its productivity remains in a poor condition due to prevailing diseases of livestock. The shortage of the veterinarians is one of the reasons of the low productivity. Accordingly the technical cooperation for five years by the Grant Aid and the Technical Cooperation is being carried out since the conclusion of the record of discussion on 22nd of January in 1985 to educate veterinarians on a high technical level.

At the substantial commencement of the cooperation, the University of Zambia requested to establish the supplementary paddocks for raising laboratory animals required for the experiment in veterinary education. In response to the request, the Government of Japan sent the survey mission to Zambia. Consequently the purpose of this survey is to formulate the detailed plan on the Model Infrastructure Improvement Work to establish the veterinary paddocks affiliated to the University.

1-2 Organization of the Team

Members of the Japanese Implementation Design Team are as listed below.

MENBER'S LIST

OF

JAPANESE DETAIL DESIGN SURVEY TEAM FOR

CONSTRUCTION OF MODEL INFURASTRUCTURE

	ASSIGNMENT	NAME	PRESENT POSITION
1.	Leader & Livestock Farm Planning	Mr Katsuyosi KOMAMURA	Deputy Director Agricultural Design Division Agriculture & Fisheries Development Hokkaido Development Bureau
2.	Coordination	Mr. Masayasu YAMAGATA	Deputy Head , Livestock Development Division, Agricultural Development Cooperation Department,JICA
3.	Livestock Farm Design	Mr. Asao YAMADA	Director, Engineering Division Taiheiyou Consultant Co. Ltd.
4.	Civil Engineering	Mr. Yasuki YOSHIDA	Engineering Division Taiheiyou Consultant Co. Ltd.

No.

1-3 Itinerary of the team

NO.	DATE	REMARKS
1	20 Oct.	Tokyo →
2	21 "	
3	22 "	→ Lusaka Courtesy visits to and arrangements with Embassy and Japanese Team in Lusaka.
4	23 "	Courtesy visits to and arrangements with Ministry of Finance and University of Zambia (UNZA)
5	24 "	Independence Day
6	25 "	Visit to the University Farm and NCSR
7	26 "	Internal meeting
8	27 "	"
9	28 "	Investigation at the project site
10	29 "	meeting with MR. MWEENE and staffs concerned of UNZA.
11	30 "	Investigation at site
12	31 "	Visit to Ministry of Finance and explain about the project and Model Infrastructure Work.
13	1 Nov.	Sign for the Supplementary Note between Leader and Parmanent Secretary MR. E.S.S. NEBWE
14	2 "	Visit to commercial farms
15	3 "	Internal meeting of the Team
16	4 "	Lusaka → Leader and M. Yamagata left for Japan
17	5 "	
18	6 "	→ Tokyo
19	7 "	Messrs. Yamada and Yoshida, members of the Team, remained at the site to continue the survey
}	}	until 2nd Dec. and came back to Japan on 4th Dec.
44	2 Dec.	→ Lusaka
45	3 "	
46	4 "	→ Tokyo

1-4 Personnel concerned

(1) MINISTRY OF FINANCE AND NATIONAL COMMISSION FOR DEVELOPMENT PLANNING

MR. E.S.S. NEBWE	PERMANENT SECRETARY
MR. SIAME	SENIOR ACTING SECRETARY
MR. ZIMBA	ASSISTANT SECRETARY

(2) UNIVERSITY OF ZAMBIA

DR. J.M. MWANZA	VICE CHANCELLOR
PROF. B.A. MWEENE	DEPUTY VICE CHANCELLOR
PROF. K. MWAULUKA	PRINCIPAL CAMPUS OF LUSAKA
PROF. R.P. LEE	DEAN, SCHOOL OF VET. MED.
PROF. C.E.A. LOVELACE	SCHOOL OF VETERINARY MEDICINE
DR. M.N. SHANDOMO	"
DR. B. YERBA	"
DR. R. McCRACKEN	"
DR. R. THOMAS.	"
DR KOOMSON	"
DR. J. HOUSKA	"
DR. J. MARCANIK	"
MR. R.V.J. GRIFFIN	"
MR K.M MIJIMAN	"
MR NAIK	"
MISS. T. BUCKLEY	"

(3) NATIONAL COUNCIL FOR SCIENTIFIC RESEARCH

DR.	CHIDEDA	REPRODUCTIVE PHYSIOLOGY
MR.	HARRISON	NUTRITION
MR.	MULILO	TICK
MR.	NSOFRISO	REPRODUCTIVE PHYSIOLOGY
MR.	NJAPAU	MYCOTOXINS
MRS	MUZUNGAILE	MYCOTOXINS
DR.	PURDIKAL	TICK CONTROL

(4) Japanese embassy in Lusaka

MR.	YOSUKE YOSHINAKA	COUNCILOR OF AN EMBASSY
MR.	KYOHEI ISHIDA	SECOND SECRETARY
MR.	TADAO MIYAKAWA	ATTACHE EMBASSY OF JAPAN

(5) JAPAN OVERSEAS COOPERATION VOLUNTEERS IN LUSAKA

MR.	HIROJI YAMAGUCHI	RESIDENT REPRESENTATIVE
MR.	OSAMU KOSEGAWA	LIAISON OFFICER

(6) NIKKEN SEKKEI LTD

MR.	MUTSUO SATO	RESIDENT ARCHITECT

(7) SHIMIZU CONSTRUCTION CO., LTD.

MR.	MICHIRO MIWA	PROJECT MANAGER
MR.	TAKANORI KITAMURA	ADMINISTRATIVE MANAGER

(8) JAPANESE EXPERTS

DR. RUIZO ISHITANI	PROJECT LEADER
DR. KIHEIJI SHIMIZU	DEPT. OF MICROBIOLOGY
DR. SHIGEO KITAOKA	ENTOMOLOGY
DR. YUSUKE TADA	CHIEF RESEARCHER
MR. MASAE TERAMURA	SENIOR COORDINATOR
MR. EIJI HASHIMOTO	COORDINATOR

1-5 Report with regard to the result of survey

1. Terms of reference of the Team

(1) Explanation to Zambian side on Supplementary Note on the Record of Discussion and other procedure especially method of construction contract

(2) Investigation and hearing regarding the request from Japanese experts and Zambian side on the implementation work of the Veterinary Paddock affiliated to the University.

(3) Investigation of present conditions (topography, soil, climate, water resource etc.)

(4) Design and cost estimation for the construction of the Veterinary Paddock.

(5) Data collection needed for the implementation of the work.

2. Details of the request on the construction of the Veterinary Paddock

(1) The facilities for the veterinary education are under construction. However paddocks to hold animals necessitated for the education are not included. So that the practice in handling animals depends on the private pasture for the moment.

In this respect, the construction of the veterinary paddock is requested and it has following objectives.

a. These paddocks will be used to hold clinical cases being treated in the clinic.

b. These paddocks will be used for the accomodation of experimental animals for the school.

c. These paddocks will be used to let students well acquainted with the handling of animals.

d. These paddocks will be used to train students for reproduction of animals as well as small scale animal production.

(2) The project site

Land for this project is prepared by the University.

(3) Outline of the construction

As mentioned in 4-3-1), following construction items are included:

Concrete block wall
Land grading
Seven paddocks
Holding sheds and hay stock
Irrigation facilities
Spray race
Drain canal
Deep well etc.

3. Meeting with Zambian personnel concerned

(1) Supplementary Note on the Record of Discussion
(Refer attached appendix No 2.)
As the organization of N.C.D.P. has been reformed recently and this organization is controlled by the Minister of Ministry of Finance and N.C.D.P.; the signer of the Note is the Permanent Secretary Mr. E.S.S. NEBWE instead of acting Parmanent Secretary of N.C.D.P.

(2) Miscellaneous procedure
(Refer attached appendix No.3)
with regard to the time of the commencement of the construction, it is anticipated in May 1986, taking account the time for necessary procedure which are to be settled befor the commencement, such as

the contract with the contractor, dispatch of the expert for the construction administration and purchase and delivery of the materials and facilities donated by Japan.

(3) Outline of the construction work

a. Project site

The area located between buildings of the veterinary school and Kalingalinga Road. Its area is about 9 ha.

b. Paddock

Seven paddocks are to be constructed including one handling area.

c. Road, drain canal

d. Irrigation facilities

Each paddock is to be irrigated by means of sprinkler irrigation method.

e. Deep well

Its depth is estimated to be 60 m and diameter of casing is 150 mm.

f Surrounding wall and fencing

The project site is to be surrounded by tall concrete block wall. Inside of it is divided by the barbed wire fence.

g. Miscellaneous facilities

Hay stock

Corral

Spray race

Crush

Holding shed

Loading ramp

h. others

- The power source shall be provided near the deep well by UNZA.
- If necessity arises, equipments and materials will be donated.
- The construction supervisor will be despached, if necessary.

APPENDIX NO.1 別紙 1

Minutes of Preliminary Meeting for Experimental Pasture Plan

Date & Time: Oct. 18, Friday, 9.00 - 11.00

Place : Conference Room, School of Mine

Participants : Prof. Lee, Prof.Lovelace, Prof. Ishitani, Prof. Shimizu, Mr. Griffin, Dr. Yeboa, Mr. Hashimoto, Mr. Ishida (Japanese Embassy), Mr. Naik (Acting Chief Architect)
Mr. Teramura (Minutes Taker)

1) Purposes of experimental pasture.
Early July, before JICA had opened national committee meeting in July 12th, the purposes of experimental pasture, was intesively discussed among the school of veterinary medicine, and transfered to JICA by telex as below :

a. These paddocks will be used to hold clinical cases being treated in the clinic.

b. These paddocks will be used for the accomodation of experimental animals for the school.

c. These paddocks will be used to let students well acquainted with the handling of animals.

d. These paddocks will be used to train students for reproduction of animals as well as small scale animal production.

However, when JICA office submitted these description to the national committee, they have deluted last part of sentence " small scale animal production ". Originally, this part of the words, meant some primary preparation such as fraying skins, carcass preparation or hand milking. Apart from minor modification, the principal aim of the experimental pasture was approved by the national committee and budget was allocated for the development.
With this background in mind, Prof. Lee pointed out that we should make priority order on the purposes of the experimental pasture, namely,

a. First priority should be placed to keep animals for experimental uses. Although we may be able to buy animals from local farm in some occasion, we cannot relay on chance in order to proceed timely arranged veterinary education. We need constant supply of animals.

b. Second priority must be placed on the observation of clinical cases. Sequencial development of diseases must be observed for teaching purpose. In this relation, non-infectious diseased animals could be hold in paddocks.

c. Next priority should be given to the controlled experiment. Experiment has to be observed timely in sequence.

d. Last priority should be given to the importance of handling animals.

2) It was also pointed out that we still have to be engaged with tied farmers, since the capacity of experimental pasture is limited.

3) It was pointed out that some consideration would be required for the second phase enlargement, because once heavy concrete block fence were established, between the site of first phase and that of second phase, it would be rather costly to remove it for expansion. However, it was also recognized that most of the expected site for expansion, seemed to belong to the school of agriculture. Therefore, expansion would not be materialized in near future.

4) Then, discussion was continued regarding the number and the kind of animals. Prof. Lee pointed out that the animals to be kept, would be cattle, sheep, goat and horse, mainly large and small ruminants. Small animals like pigs or chicken are not desirable because they need quite amount of concentrated foods, which are expensive. Ruminants are easier to keep with some hay supplement. Because of traditional requirement, at least one paddock should be allocated for horses. Special fencing must be considered for horse paddock. Barbed wire fence will not be used for it.

5) The problem of shelter was discussed. The difficulty to obtain roof material in local market, was suggested. It was also pointed out that the order should be placed at least four months before, if local materials were to be purchased. The possibility to import pre-fabricated house frame was also considered. The trees would give good shelters. However, at least 6 years would be required to grow. In a mean time, huts are essential.

6) Then the holding capacity of the pasture, was discussed. According to the western standard, one cattle per acre is preferable. Subsequently, 22 heads of cattles or 100 heads of sheep could be kept in this pasture.

7) The advantage to use spray-race rather than dip, was suggested. The necessity to have weighing machine for animals was also pointed out.

8) Preliminary estimate , made by Mr. Griffin, was presented. However, because of recent devaluation of local currency, new estimate would be necessary. Regarding the materials for fence, it was pointed out that block concrete of local made, would be much cheaper than wire fencing. The advantage of irrigation in comparison with the cost of feed purchase, was discussed and agreed. One bore-well, now installed in new building, is not sufficient to supply to the pasture. One more bore-well will be necessary.

9) The source of animals, was discussed. It was agreed that animals would be purchased with current budget of UNZA.

10) The maintenance cost of experimental pasture, was discussed. Four labours including one superviser was envisaged. They will be recruited by university and the cost of feeds and general expenses are to be paid by university. Small amount of foreign currency might be required, but it would not be serious problem.

11) The problem of counter part for JICA team was discussed, and it was agreed that all participants would take part in respective field of knowledge.

別添 2

APPENDIX NO.2

SUPPLEMENTARY NOTE ON THE RECORD OF DISCUSSIONS
ON THE TECHNICAL COOPERATION FOR
THE UNIVERSITY OF ZAMBIA:VETERINARY EDUCATION PROJECT

The Japanese Detailed Design Survey Team organized by the Japan International Cooperation Agency (hereinafter referred to as "JICA") and headed by Mr. KATSUYOSHI KOMAMURA and the authorities concerned of the Government of the Republic of Zambia exchanged views on the special measures to supplement a portion of the local cost expenditures on the Technical Cooperation for The University of Zambia:Veterinary Education Project (hereinafter referred to as "the Project").

As a result of the discussions, both sides agreed to recommend to their respective Governments the following for the successful implementation of the Project.

For fostering the smooth promotion of the Project, in accordance with the laws and regulations in force in Japan, the Government of Japan will take necessary measures through JICA to supplement a portion of the local cost expenditures for the execution of the improvement works of the physical infrastructure of the Project, such as construction work of the veterinary paddock and related facilities in the Project site when necessity arises.

Lusaka, November 1, 1985

Katsuyoshi Komamura

Mr. KATSUYOSHI KOMAMURA

Leader, the Japanese Detailed
Design Survey Team,
Japan International Cooperation
Agency, Japan.

Mr. E.S.S. NEBWE

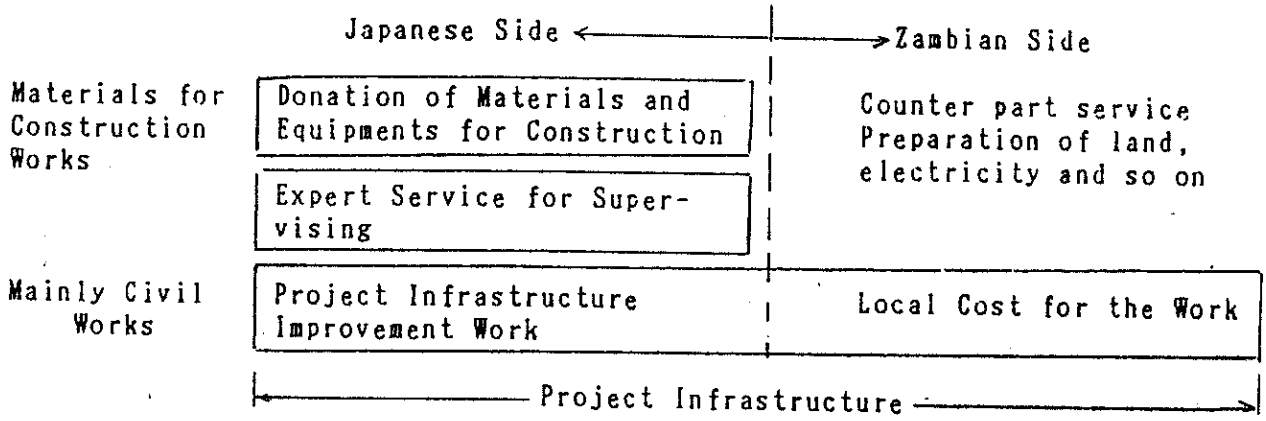
Permanent Secretary
Ministry of Finance and National Commission
for Development Planning,
Republic of Zambia.

別添 3

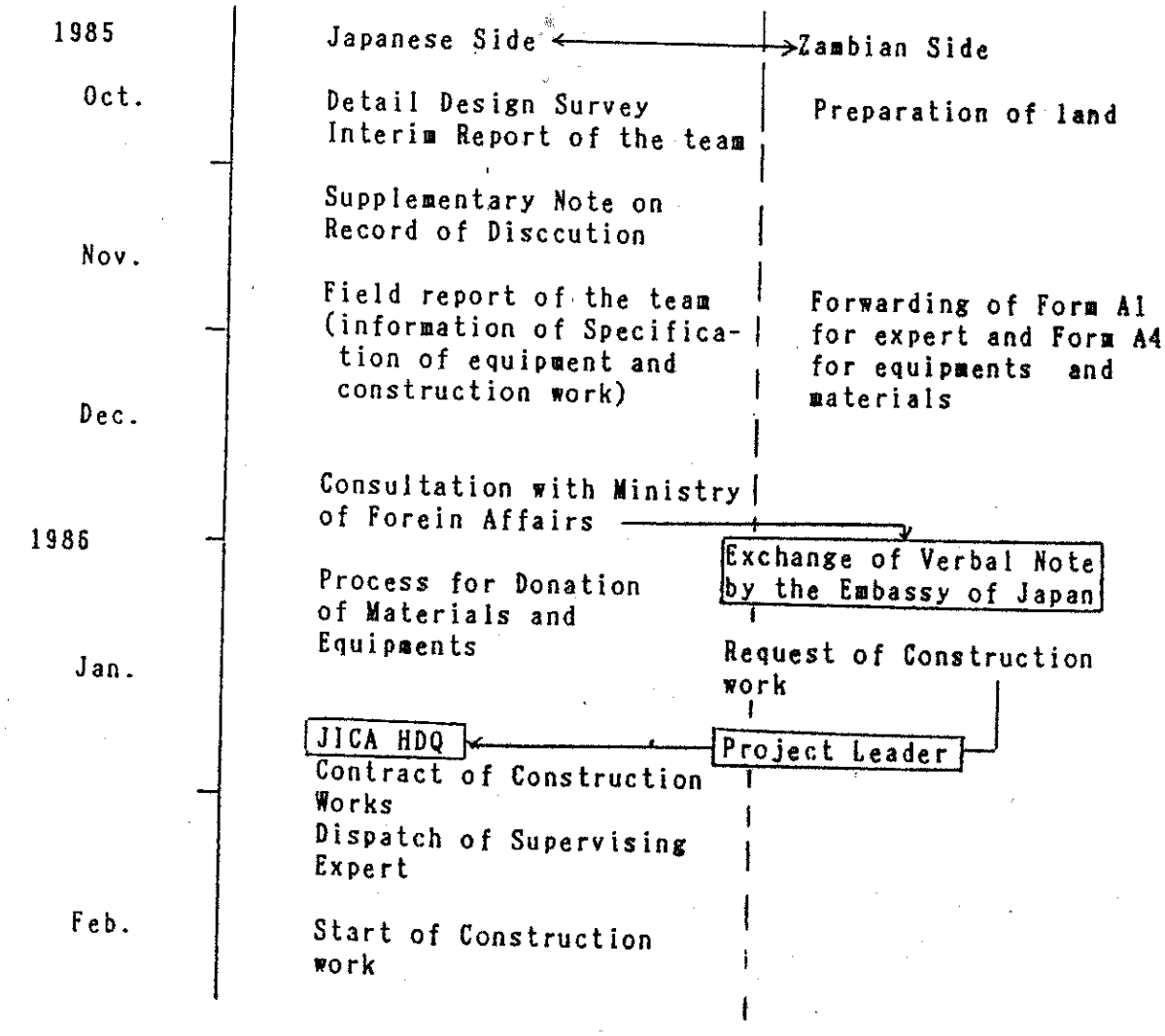
APPENDIX NO.3

OUTLINE OF THE SYSTEM OF PROJECT INFRASTRUCTURE IMPROVEMENT WORK

1. This is the budget of Japanese Government to supplement a portion of the local cost expenditures, and is very effective if it is combind with other budget as shown below;



2. (Tentative) Schedule of the Work



Mr. E.S.S. Nebwe, Permanent Secretary, Ministry of Finance
and National Commission for Development
Planning.

Date: November 4, 1985

Subject: Summary Report of the Detailed Design Survey on the Modle Infrastructure Imprevement Works (Veterinary Paddock) for the University of Zambia: Veterinary Education Project.

Dear Sir,

The Japanese Detailed Survey Team (herein-after referred to as "the Team" organized by Japan International Cooperation Agency (herein-after referred to as "JICA") visited the Republic of Zambia, from October 22nd to November 4th (up to December 2nd for the consultant), for the purpose of formulating a detailed plan on the Model Infrastructure Improvement Works which is named as Veterinary Paddock, (herein-after referred to as "the Works") for the University of Zambia: Veterinary Education Project (herein-after referred to as "the Project").

During its stay in Zambia, the Team exchanged views and had a series of discussion with Zambian authorities concerned of the Project on the necessary measures to be taken by both governments for successful implementation of the Works for the Project.

As the result of exchange of views and surveys, I have the honour of submitting you the Summary Report of the Team attached hereto, showing the outline of the design of the Works which will be consolidated by consultant members during their stay in Zambia.

/2...

Finally, I express my deep appreciation for your kind cooperation and I hope that necessary arrangement will be taken for the effective implementation of the Works.

Yours sincerely,

Katsuyoshi Komamura

KATSUYOSHI KOMAMURA
TEAM LEADER

Japanese Detailed Design Survey Team for the
Model Infrastructure Improvement Works
(Veterinary Paddock) for the Univerity of
Zambia: Veterinary Education Project.

cc. Professor Mweene - Deputy Vice-Chancellor, UNZA
cc. Embassy of Japan
cc. Mr. Yamaguchi, Resident Representative of JOCV, JICA

SUMMARY REPORT

OF

THE DETAILED DESIGN SURVEY

FOR

VETERINARY PADDOCKS

IN

THE UNIVERSITY OF ZAMBIA

I. Background and purpose of the survey: Although stock-farming has been traditionally performed in Zambia, its productivity remains in a poor condition due to prevailing diseases of livestock. The shortage of the veterinarians is one of the reasons of the low productivity. Accordingly the technical cooperation for five years by the Grant Aid and the Technical Cooperation is being carried out since the conclusion of the record of discussion on 22nd of January in 1985 to educate veterinarians on a high technical level.

At the substantial commencement of the cooperation, the University of Zambia requested to establish the supplementary paddocks for raising laboratory animals required for the experiment in veterinary education. In response to the request, the Government of Japan sent the survey mission to Zambia. Consequently the purpose of this survey is to formulate the detailed plan on the Model Infrastructure Improvement Work to establish the veterinary paddocks affiliated to the University.

II. Guideline for the construction of the veterinary paddocks.

1. Location and area

The open area at the Lusaka Campus of UNZA between the New Building of Veterinary School and public road called Kalingalinga Road was proposed to be the construction site of veterinary paddocks. The area is estimated to be about nine hectares. (Refer fig. - 1)

2. Proposed constructions and facilities.

(1) Seven paddocks including one handling area. They are to be properly cleared, ploughed, harrowed and sown.

(2) Road and drain canal.
The existing road which is being paved at present is to be extended straightly to the public road by the University. The unlined drain canal will

be excavated along the proposed road by JICA.

(3) Installations of irrigation pipeline.
The proposed paddocks are to be irrigated by means of the sprinkler system. Hence, the properly located pipeline network is to be necessitated for this purpose.

(4) Well drilling.
As there is no surface water resources in this area, the deep well is proposed to be constructed in the handling area.

Its diameter is estimated to be 200mm and the depth of borehole is about 70 meters.

(5) Wall and fencing.
This area is to be surrounded with a burglarproof wall made of concrete blocks. Seven paddocks surrounded within the wall are to be divided by the barbed wire fence.

(6) Handling area.
Following facilities are proposed to be constructed in the handling area. Their type and size will be decided after the detailed investigations.

a. Hay stock
b. Corral
c. Spray race
d. crush
e. chute
f. Handling sheds
g. Loading ramp

III. Others.

(1) Preparation of Electricity.
Two pumps for the deep well and the sprinkler system will be furnished. The capacity of the motor is estimated to be about 37KW-400V and 22KW-400V respectively. The power supply

for these pumps will be prepared by UNZA.

(2) A letter of the request addressed to the Embassy of Japan.

If there is the necessity of Japanese Cooperation on the construction of the veterinary paddocks, a formal letter to request the Japanese Cooperation to implement the construction work should be forwarded by the name of the Permanent Secretary of the Ministry of Finance to the Embassy of Japan.

(3) Submissions of the Interim Report of the Detailed Design Survey.

Messrs. A. Yamada and Y. Yoshida will submit the Interim Report of the Detailed Design Survey of the Project to the concerned organizations before their departure on December 2nd, 1985.

(4) Donations of Equipments and Materials for Construction.
If necessity arises, equipments and materials for construction will be donated, and Form A4 will be forwarded to the Embassy of Japan as soon as possible.

(5) Dispatch of the Short Term Expert.
If necessity arises, the construction supervisor will be dispatched, and Form A1 will be forwarded to the Embassy of Japan as soon as possible.

APPENDIX NO.5

Minutes of the meeting regarding Veterinary Paddocks

Chairman : Prof. B.F. Mweene, Deputy Vice Chancellor

Date ; Oct. 29, 1985

Time : 14.30

Place : Committee Room B

Participants : Prof. Mweene, Prof. Lee, Prof. Lovelace, Prof. Ishitani Prof. Shimizu, Mr. Griffin, Dr. Yeboa, Mr. Mwanza, Mr. Komamura (Team Leader) Mr. Yamagata, Mr. Yamada Mr. Yoshida, Mr. Teramura (minutes taker)

1) By request made by chairman, minutes taker explained the outcome of last discussion, which was taken place between visiting team and school of veterinary medicine, in the afternoon of Oct. 23rd, as well as some findings of following survey, made by visiting team.

   a. Official name for this project was discussed. Several names were suggested, but after discussion, the official name was agreed to be " Veterinary Paddocks ".

   b. Purposes of veterinary paddocks, had to be clearly defined, since this paddocks should be effectively utilized for veterinary education. Prof. Lee suggested that among suggested purposes, there should be priority order. First priority would be given to the holding of experimental animals, but, secondary, the observation of clinical cases, was considered important for the education. The holding of animals with non-effectual diseases, in some instances, was considered and unanimously agreed.

   c. Holding capacity of paddocks were discussed. In order to minimize feeds purchase, one cow per acre was considered as good standard. In consequence, holding capacity of this paddocks, was figured to be 22 heads of cattles, or 100 sheep. This will give the figuring base of maintenence cost.

   d. Expected position for boring well was estimated by Lusaka water bureau. Although final data were not available yet, underground water reservoir seemed to be located along the expected extension of chancellor's road.

   e. Extension of chancellor's road which has been conveniently used by local people, is not straight to Kalingaling road, but rather curved toward Great East Road. For construction purpose, it is assumed, that futureextension of chancellor's road would be straight to Kalingalinga road.

   f. Necessity to establish sub-station for power supply, was suggested. It was agreed to ask Nikken Sekkei, regarding availability of present sub-station at new building.

   g. Shelter for animals are required in each paddock. Simple huts without walls, could be built. However, in same time, quick growing trees should be planted for future shelters.

h. The advantage of spray-race, compared with dipping, was recognized. Since Mr. Hashimoto confirmed that weighing machine was not included in coming JICA supply list, this item has to be included in the supply for veterinary paddocks.

i, Preliminary leveling and plowing was considered in order to prevent expected troubles with local people who may illegally start cultivation for maize raising, possibly next month. Chairman suggested that the university will plow most of the area within few weeks.

j, Kind of grass to be seeded right after plowing, was discussed. Mr. Griffin agreed to consult with people in the school of agriculture regarding suitable mixture of grass for local condition.

k. Problem of "work permit" for expected Japanese constructor or supervisers, was brought up. Chairman agreed to apply their work permit through the university.

l. It was agreed that "Import Licences" for importing items for this project, will be applied through the university.

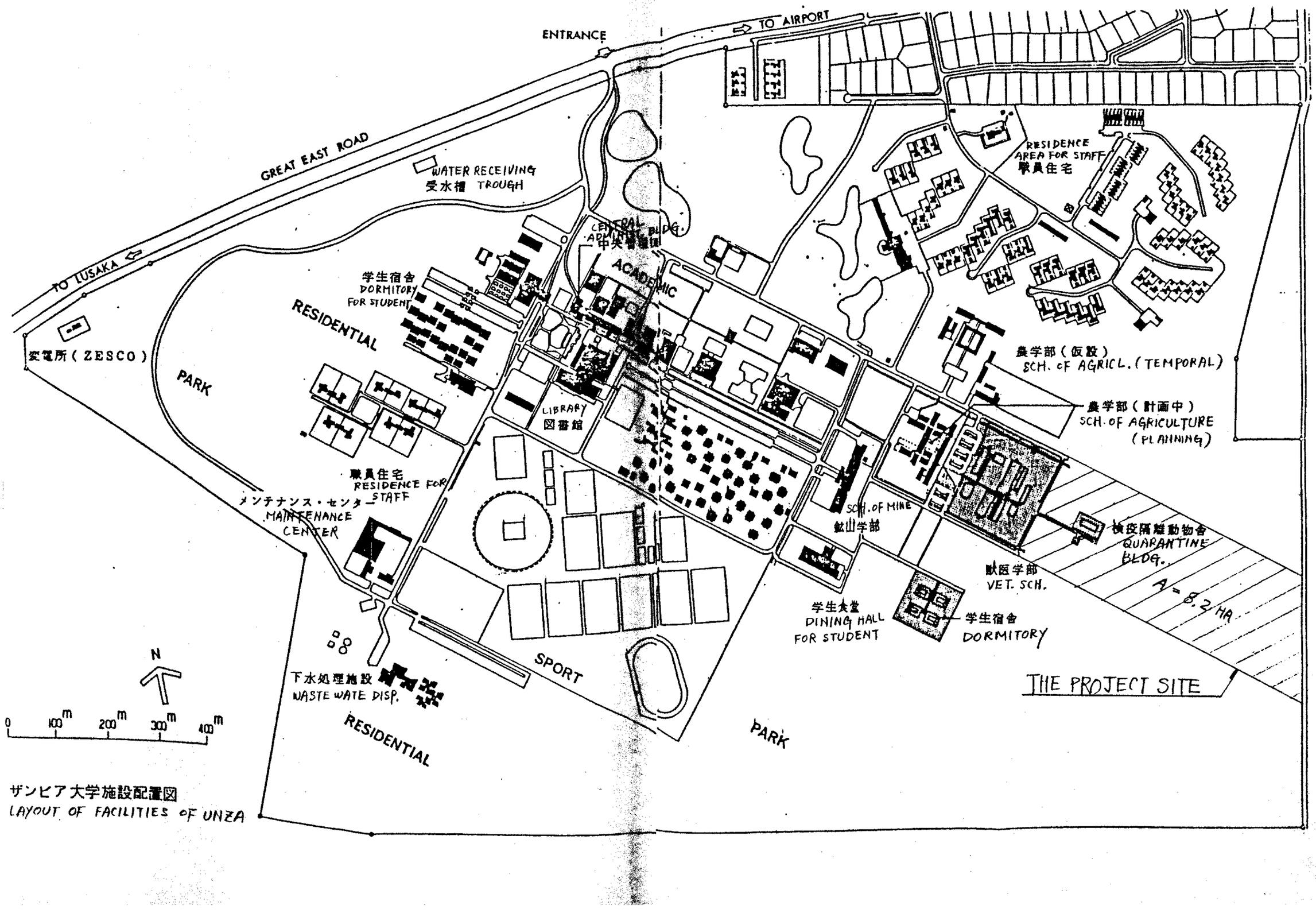
m. Managementof the paddocks will be performed by the university.

n. Mr. Yoshida of JICA team, suggested three alternatives for fence design. However, it was unanimously agreed that the protection from thieves would be first consideration rather than landscaping. Therefore, it was agreed to have concrete block wall of 2.5 m high on Kalingalinga road side, and 2 m high walls on left and right hand.

2) Then, the draft of record of discussion, was presented. Minutes taker explained that Japanese Embassy is now feeling some difficulties to obtain full understanding from Ministry of Finance, because previous exchange of signatures had been proceeded between NCDP and JICA. In this respect, he asked chairman for his assistance to get in touch with Ministry of Finance in order to eliminate any misunderstnding. Chairman kindly agreed to take action with this regard.

The meeting adjourned.

LAYOUT OF FACILITIES OF UNZA



ザンビア大学施設配置図
LAYOUT OF FACILITIES OF UNZA

CHAPTER 2. PRESENT SITUATIONS OF ZAMBIA

2 - 1 NATURAL CONDITIONS

1) POPULATION, AREA & GEOGRAPHY

Population (1982) : $6,160 \times 10^3$

Area : 750×10^3 km^2

Population density : 8.2/km^2

The greater part of the plateau of Zambia is composed of level surface (pediplanes) which were formed during previous cycles of pediplanation. Since the large rivers show signs of superimposition it is likely that later rocks than those now exposed have been stripped off from above the present surface. Many of the pediplane surfaces are characterized by poor drainage because of the level nature of the terrain which inhibits run-off, while infertile soils including much laterite are of general occurrence on the level plains. More fertile soils, however, are found round the margins of these plains where dissection is taking place and where there are therefore unfavourable conditions for the development of latelite.

There main physical divisions may be

recognised — the western wing, the central "waist" and the eastern wing. The western wing includes a large part of the upper Zambezi basin, much of which is flooded during the rains, and the Kafue basin. The Kafue itself is entrenched in a deep valley in its "hook" section, while between the northern part of the hook and the Zambezi drainage to the west lies the extensive Busango swamp. After rounding the bend which leads the river eastwards the Kafue breaks through the Mashi Teshi Gorge into the Kafue flats below which lies another gorge — the Kafue Gorge — above the confluence with the Zambezi. Notice the Batoka Plateau south of the Kafue; this area is well drained, but is a granite area with infertile soils.

Most of the narrow "waist" of Zambia lies for the most part along the watershed between the Kafue waters on the one hand, and on the other hand, water draining eastwards to the Luangwa river which occupies a deep fault trench in the eastern wing of the country. To the east and south-east of this trench the ground rises towards the rift valley highla-

nds in Malawi and towards the Manica Plateau along the Mozambique border. To the north-west of the Luangwa trench the Muchinga Mountains act as a divide between the waters of the Luangwa and those of the Zaire; extensive areas of swamp, especially the vast Bangweulu Swamp, occupy much of the plateau in the northern part of the eastern wing, though in the north-east the rift valley highlands occupy a narrow belt.

2) CLIMATE

The main variations in climate which occur in Zambia are due to changes in latitude (the latitudinal extent is 9 degrees) and to variations in relief. Rainfall, for instance, decreases on the whole from north to south, from about 1,500 mm a year just south of Lake Tanganyika to just under 750 mm in southern Barotseland, while the deep Zambezi, Luangwa and Kafue trenche are hotter and more humid than the plateau. Dispite this high humidity, however, they experience comparatively low rainfall owing to rain shadow effects, especially in the case of the Luangwa. The general pattern of climate in Zambia is illustrated by the figures for Lusaka (Fig. 2-1). Notice that the rainy season begins in October or November and continues until March or April, while the mean annual range of temperature is about 20°C.

The map of the isohyet of Zambia is also illustrated in Fig. 2-2.

Fig. 2-1 THE GENERAL PATTERN OF CLIMATE AT LUSAKA

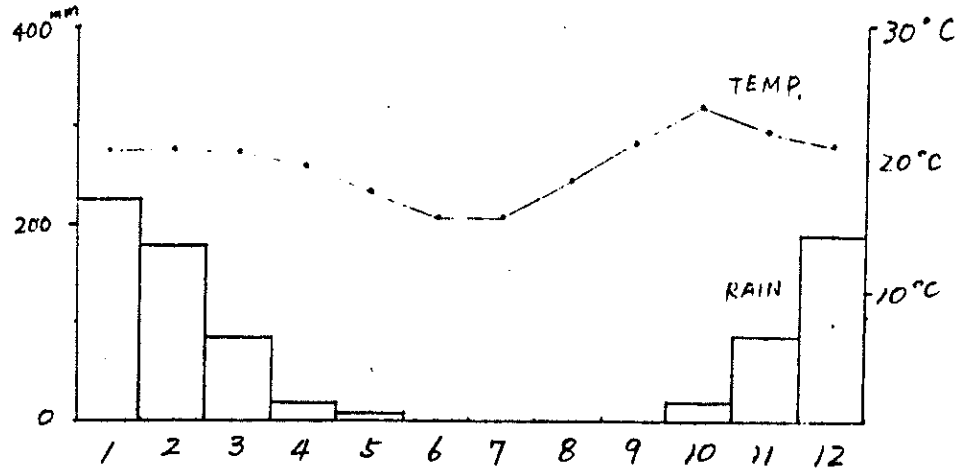
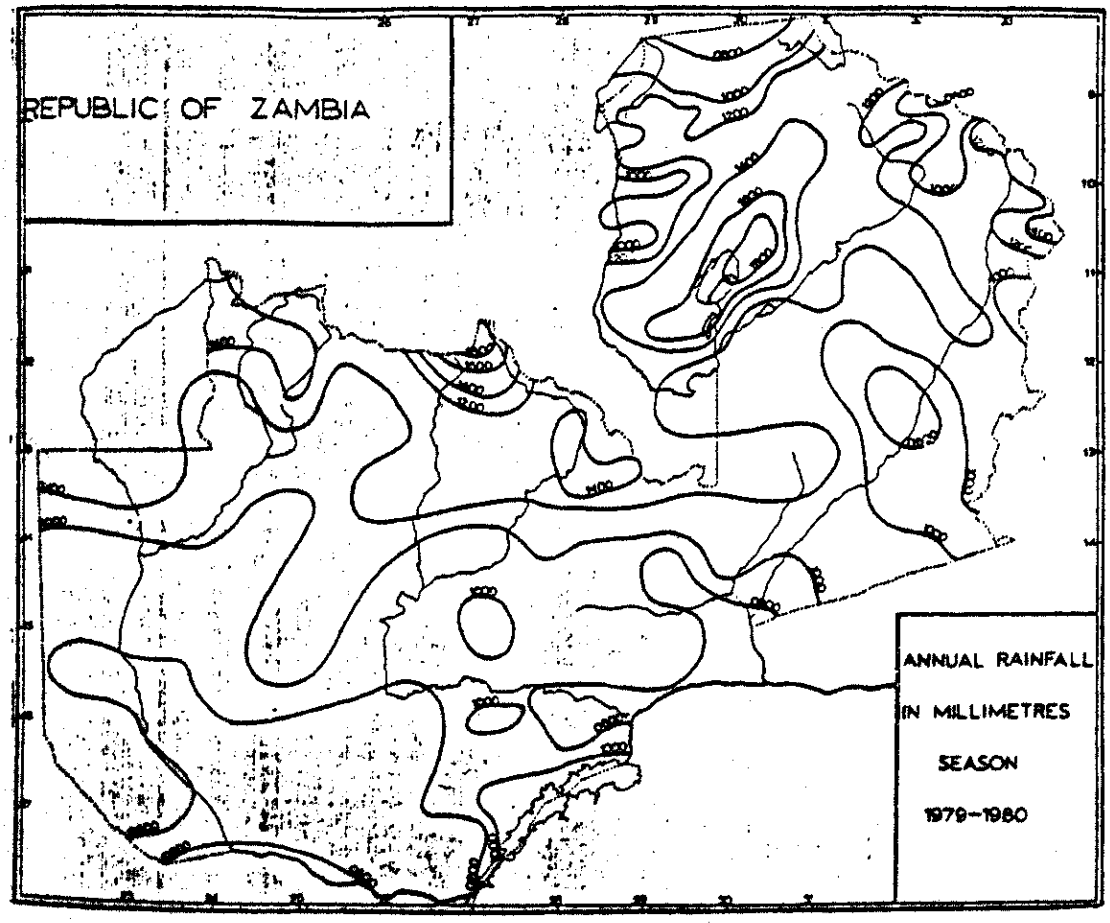


Fig. 2-2 THE ISOHYET OF ZAMBIA



2-2 ECONOMY & FOREIGN TRADE

The economy of Zambia is supported by the export of mineral resources, especially copper. According to the monthly digest of statistics, Zambia was an exporting country of maize until 1978, and also of wood until early 1970s. However no products except minerals can be exported recently

On the other hand many kinds of goods are imported. Oil and its related products are the most costly imported material, followed by general machineries, cars and fertilizer. The amount of import of foodstuff can not be ignored.

The auctioning system of Kwacha started on October 11, 1985 when the exchange rate was pegged at K5.01 per dollar. The Kwacha, however, continues to depreciate by more than 120 per cent when compared to the preauction rate of K2.43 a dollor. The exchange rate is subject to fluctuations recently.

As a result the price of imported material begins to increase and that of the material produced in Zambia is also going to increase.

The figures and indexes of national economy are shown in the Table 2-2-1. The total exports and imports by year, the exports of principal commodities and the value of imports by divisions are shown in the Table 2-2-2, 2-2-3 and 2-2-4 respectively.

No.

TABLE 2-2-1 INDEXES OF NATIONAL ECONOMY

SOURCE : Monthly Digest of Statistics

	Unit	1977	1978	1979	1980	1981	1982	1983	1984
1. Population (Mid-year est)	million	5.20	5.36	5.52	5.68‡	5.87	6.05	...	..
2. Gross Domestic Product									
At current purchasers' values ...	K.million	1,986.4	2,250.7	2,660.4	3,063.6	3,485.4	3,595.3	4,181.2	4,733.3
At 1977 purchasers' values‡ ...	K'million	1,986.4	1,997.8	1,937.0	1,995.8	2,118 5	2,059.3	2,018.2	1,992.1
At 1977 purchaser's values ...	K'million	1,986.4	1,983.4	2,068.8	2,010.7	1,982 0	1,773.1	1,821.0	1,814.7
3. Per Capita Gross Domestic Product									
At current prices	Kwacha	392.0	419.9	482.0	539.4	596.8	594.3	672.2	737.3
At 1977 prices	Kwacha	382.0	372.0	350.9	351.4	362.8	340.4	324.6	310·3
At 1977 prices (Adjusted for terms of trade)	Kwacha	382.0	370.0	374.8	354.0	339.4	292.9	292.8	282.7
4. National Income									
At current market prices	K'million	1,607.4	1,809.8	2,124 3	2,495.9	3,004.1	2,870.3	3,508.3	3,910.3
At 1977 market prices (unadjusted)	K'million	1,607.4	1,616.9	1,575.5	1,671.2	1,856.6	1,778.2	1,773.2	1,770.1
At 1977 market Prices (adjusted)	K'million	1,607.4	1,512.5	1,707.3	1,686.1	1,719.7	1,492.0	1,595.5	1,592.7
5 Per Capita National Income									
At current prices	Kwacha	309.1	337.6	384 8	439.4	514.4	474.4	564.0	609.1
At 1977 prices‡ ...	Kwacha	309.1	301.7	285.4	294.2	3 17.9	293.9	285.1	275.7
At 1970 prices	Kwacha	309.1	282.2	309.3	296.8	294.5	246.5	253.3	248.1
6. Gross National Product									
At current prices	K'million	1,898.3	2,109.4	2,431.8	2,835.0	3,387.5	3,276.1	3,935.0	4,358.0
At constant 1977 prices									
At constant 1977 prices (Unadjusted)	K'million	1,898.3	1 880.5	1,788.6	1,879.1	2 078.2	1,981.5	1,945.0	1,915.7
At constant 1977 prices (adjusted)	K'million	1,898.3	1,866.1	1,920.4	1,894.0	1,941 3	1,695.3	1,747.2	1,738.3
7. Copper production, exports, price									
Production	'000 tonnes	659.8	655.6	584·5	610.2	560.6	584.8	144.0	..
Exports	'000 tonnes	666.6	589.4	651·1	621.7	551.8	268.0	...	..
LME Cash and Settlement Price per ton	Kwacha	1,01.6	1,090	1,572	1,719	1,514	1,374	198.5	..
8. Index of Production									
Mineral Production	1973—100	96.2	95.4	86.1	89.2	82.0	86.0	84.4	..
Manufacturing	1973—100	98.5	102.6	96.2	99.2	104.9	99.3	95.0	..
Electricity	1973—100	265.0	240.7	268.4	280.7	293.8	321.9	384.8	..
9. External Trade									
Exports	K'million	708.0	686.8	1,090.0	1,023.3	936.5	...	...	..
Imports	K'million	530.0	492.6	593.7	876.7	881.0	...	...	..
10. Prices									
Index Numbers of Consumer Prices									
High Income	1975—100	136.8	152.6	169.8	189.4	209.1	236.6	278.6	..
Low Income	1975—100	142.3	165.6	181.6	202.9	231.3	260.2	311.2	..
Index Numbers of Wholesale Price									
Including Copper	1966—100	211.6	246.4	306.2	334.3	352.1	378.5	465.8	..
Excluding Copper	1966—100	276 9	333 7	398.6	439.2	487.5	541.9	652.3	..
11. Employment and Earnings									
Number of employees as on 31st December.									
Zambian	'000	344	343	351	359	355*	350†	...	..
Non-Zambian	'000	26	23	23	20	19*	17†	...	..
Total	'000	370	367	374	379	373*	368†	...	..
Average annual earnings									
Zambian	Kwacha	1,566	1.740	1,657	2,301	...	...	...	..
Non-Zambian	Kwacha	7,086	6,887	6,122	8,715	...	...	...	..
12. Government Finance									
Receipts	K'million	638	686	856	1,174	1,220	1,191	1,208	..
Payments	K'million	821	815	956	1,658	1,389	1,643	1,337	..
13. Money Supply	K'million	418	420	551	535	599	727	827	..

*30th June, 1981.
†30th June, 1982.
‡1980 Census of Population and Housing.
§unadjusted for changes in terms of trade.
The constant price series is at 1977 prices unlike the previous published series which were at 1970 prices.

TABLE 2-2-2 THE TOTAL EXPORTS AND IMPORTS BY YEAR

(K'000)

	Exports			Imports	Export surplus
	Total	Domestic	Re-exports		
1970	714,964	710,388	4,576	340,711	374,253
1971	485,177	480,011	5,166	399,282	85,895
1972	541,564	536,043	5,521	402,471	139,093
1973	741,955	738,004	3,952	346,867	395,089
1974	905,091	900,428	4,663	506,636	399,455
1975	521,049	517,990	3,059	597,611	−76,562
1976	751,850	748,756	3,094	468,748	283,102
1977	708,016	706,406	1,610	529,970	178,046
1978	686,808	685,280	1,529	492,605	194,203
1979	1,090,006	1,087,250	2,756	593,640	496,366
1980 *	1,023,276	1,020,485	2,790	876,688	146,588
1981 *	936,496	929,549	6,947	924,444	12,052
1982*	950,456	945,235	5,221	929,997	−20,459
1983 *	1,047,545	1,047,545	..	893,174	154,3711

TABLE 2-2-3 THE EXPORTS OF PRINCIPAL COMMODITIES

	Copper		Zinc		Lead		Cobalt		Tobacco		Maize		Timber
	'000 Tonne	K'm	Tonne	K'000	Tonne	K'000	Tonne	K'000	Tonne	K'000	Tonne	K'000	K'000
— —	635	450.2	49,453	11,507	22,895	4,557	1,189	4,125	5,212	3,512	0,598	177	423
— —	711	490.9	60,572	16,368	26,694	5,596	2,329	8,590	4,181	2,737	1,896	100	100
— —	670	698.3	51,115	16,666	120,012	5,411	1,145	4,862	5,048	4,738	50,086	2,643	5
— —	673-4	838.5	50,227	25,162	18,776	7,150	1,894	7,926	4,872	5,798	111,212	7,632	—
— —	641.2	472.0	41,264	20,346	9,376	5,665	1,344	7,046	5,337	4,969	16,621	1,434	20
— —	745.7	688.6	51,160	26,552	14,768	4,421	2,312	15,939	4,596	5,095	0,808	513	—
— —	666.6	644.9	36,470	17,920	11,673	5,705	1,682	16,226	3,425	5,783	25,606	3,517	—
— —	589.2	597.7	35,437	17,630	6,649	3,277	1,793	36,679	1,610	3,481	61,008	7,830	—
— —	651.2	897.2	42,086	27,078	8,465	6,079	3,060	139,891	1,631	2,577	—	—	—
— —	681.1	872.4	31,781	19,597	8,749	6,528	2,059	874,92	2,537	2,714	—	—	—
— —	551.2	885.6	31,520	22,895	8,282	8,152	2,211	38,979	1,231	4,025	—	—	—
.. ..	606.6	885.4	32,992	25,002	9,888	4,687	2,451	25,879	853	1,585	—	—	—
.. ..	578-6	930.3	26,845	24,698	12,307	6,866	3,122	2,8768	1,571	3,760	—	—	—

SOURCE : Monthly Digest of Statistics

TABLE 2-2-4 THE VALUE OF IMPORTS BY DIVISIONS

(K'000)

ode No.	Description	1978	1979	1980 *	1981*	1982*
00	Live animals	540	1,193	1,173	331	360
01	Meat and Meat preparations	439	204	16	27	12
02	Dairy Products and Eggs	3,701	5,009	6,406	5,493	8,429
03	Fish and Fish preparations	1,009	943	1,326	1,354	1,375
04	Cereals and cereal preparations	14,670	23,055	22,056	37,571	29,920
05	Fruit and Vegetables	771	864	818	447	470
06	Sugar, Sugar preparations and Honey	142	618	256	121	126
07	Coffee, Cocoa, spices, Tea and Manufactures	1,086	2,059	1,530	761	562
08	Animal Foods (not unmilled cereals)	7,497	2,318	2,950	2,564	3,998
09	Miscellaneous Food preparations	1,758	1,558	2,318	2,129	4,150
11	Beverages	657	1,281	747	1,158	949
12	Tobacco and tobacco manufactures	21	18	30	17	59
21	Hides, Skins and furskins, Raw	—	7	5	—	1
22	Oil seeds and oleaginous fruit	557	1,798	208	947	31
23	Crude Rubber (including synthetic and reclaimed)	2,751	3,041	4,107	4,323	2,514
24	Wood, Lumber and cork	1,114	2,039	1,771	3,136	2,025
25	Pulp and Waster Paper	15	13	30	—	884
26	Textile Fibres (not Manufactured Into yarn Thread of Fabrics)	424	321	976	425	449
27	Crude Fertilisers and crude Minerals (excluding coal, Petroleum and precious stone)	2,268	2,318	3,056	3,654	3,717
28	Metalliferous ores and Metal scrap	30	23	93	63	59
29	Crude animal and vegetable materials n. e. s.	1,861	1,354	1,761	1,020	1,366
32	Coal, Coke and Briguettes	7,544	1	2,293	56	11,519
33	Petroleum Products and Petroleum	79,421	106,339	195,974	202,371	181,577
34	Gas, natural and manufactured	13	23	17	12	10
35	Electric current	—	—	—	—	—
41	Animal Oils and fats	1,510	1,847	1,195	1,130	1,497
42	Fixed Vegetable Oils and Fats	5,543	7,675	6,044	9,434	10,231
43	Animal and Vegetable Oils and Fats, processed and Wages of animal or Vegetable origin	99	471	145	111	87
51	Organic Chemicals	5,651	7,575	10,946	6,831	6,217
52	Inorganic Chemicals	8,734	10,105	12,707	12,828	15,092
53	Dyeing, tanning and colouring Materials	1,874	2,642	3,241	3,664	3,273
54	Medical and Pharmaceutical Products	10,866	14,732	19,625	14,287	15,209
55	Polishes, Essential Oils and toilet preparations	3,382	3,902	8,999	8,796	17,368
56	Fertilisers Manufactured	11,860	13,131	12,388	46,711	58,588
57	Explosives and Pyratechnic products	3,102	1,447	3,044	3,929	3,505
58	Plastic Materials, Regenerated cellulose and Artificial Resins	8,779	12,005	18,807	14,398	14,485
59	Chemical materials and products, n. e. s.	10,784	13,589	18,530	14,857	15,208
61	Leather, Leather manufactures, n. e. s. and dressed furskins	371	509	1,097	972	1,016
62	Rubber manufactures n. e. s.	6,778	8,071	13,827	12,715	14,856
63	Wood and Cork Manufactures (excluding furniture)	2,114	1,063	1,972	1,445	1,795
64	Paper, paper board and manufactures	10,489	13,195	15,781	14,176	14,233
65	Textile Yart, Fabrics and Related products	28,420	32,986	41,570	38,222	46,105
66	Non-Metallic mineral Manufactures n. e. s.	7,973	9,706	16,533	14,804	9,924
67	Iron and Steel	18,241	26,552	44,028	43,146	42,522
68	Non-Ferrous Metals	2,815	4,911	3,716	3,771	5,250
69	Manufactures of Metal, n. e. s.	20,865	24,695	40,032	44,227	30,072
71	Power Generating machinery and equipment	11,225	13,852	15,947	14,821	14,193
72	Machinery specialised for particular Industries	29,515	30,119	61,820	65,584	77,093
73	Metal working machinery	1,553	3,029	4,265	4,843	3,019
74	General Industrial Machinery and equipment n. e. s. and Machine Parts, n.e.s.	42,475	44,271	66,590	80,828	88,636
75	Office machine and automatic data processing equipment	1,778	2,212	3,951	3,061	2,286
76	Telecommunications and sound recording and reproducing apparatus and equipment	15,458	9,829	18,054	17,676	12,158
77	Electrical machinery, apparatus and appliances and electrical parts thereof	18,672	20,856	27,403	25,696	35,947
78	Road Vehicles (including air cushion Vehicles)	42,873	58,128	88,059	87,700	79,730
79	Other Transport equipment	12,316	10,865	15,933	14,235	7,934
81	Plumbing, Heating and Lighting Fixtures and Fittings	1,241	1,077	1,690	1,593	1,787
82	Furniture and Parts thereof	160	248	598	402	376
83	Travel goods, handbags and similar containers	159	174	301	150	122
84	Clothing	1,812	3,094	3,754	3,875	2,857
85	Footwear	1,448	2,576	2,783	2,989	2,912
87	Professional Scientific and controlling instruments and apparatus, n. e. s.	4,439	5,589	7,837	8,441	7,454
88	Watches, Clocks, Photographic apparatus and Optical Goods, n. e. s.	1,701	4,000	2,696	2,564	2,395
89	Miscellaneous manufactured articles, n. e. s.	7,053	7,016	9,642	8,592	9,055
91—99	Commodities and Transactions not classified elsewhere in the SITC.	410	1,449	772	1,954	938
	Grand Total	492,827	593,640	876,697	924,444	929,997

*Provisional

SOURCE: Monthly Digest of Statistics

2-3 AGRICULTURAL SITUATIONS

1) LAND USE

The total area of Zambia is reported to be 75,261,000 ha and the actual land excluding principal rivers and lakes is 74,072,000 ha. The area of arable land is 51,580 ha which is 6.8 per cent of total area. The area of each category is listed in Table 2-3-1.

The area of irrigated farm land is 1800 ha which is less than 1 per cent of arable land. In spite of that Zambia has a long dry season, the ratio of irrigated land is very limited. This shows that the agriculture of Zambia is still in a developing stage.

TABLE 2-3-1 LAND USE OF ZAMBIA (1982)

ITEMS	AREA ($10 km^2$)	RATIO (%)
Total area	75,261	100
Area of land	74,072	98.4
Arable land	5,158	6.9
Grass land	35,000	46.5
Forest and wood land	20,250	26.9
others	13,664	18.2
Irrigated farm land	18	—

2) PRINCIPAL PRODUCT

The principal products are sugarcane, maize, sunflower, ground nut, tobacco, wheat and rice. The production, area and yield of these products are shown in Table 2-3-2.

TABLE 2-3-2 PRODUCTION, AREA AND YIELD BY CROP, 1983-84

PRODUCT	1984			1983		
	PRODUCTION	AREA	YIELD	PRODUCTION	AREA	YIELD
	10^3t	10^3ha	t/ha	10^3t	10^3ha	t/ha
FOODSTAFF						
MAIZ	872	506	1.7	935	547	1.7
MILLET	14	19	0.7	13	20	0.7
SORGHUM	15	22	0.7	13	17	0.8
WHEAT	12	3.6	3.3	18	4.5	4
PADDY RICE	9.2	8.7	1	9.6	7.0	1.4
COMMERCIAL CROP						
SUGARCANE	141	9.7	14.5	132	9.5	13.9
GROUND NUT	13	30	0.4	11	31	0.4
SUNFLOWER	40	58	0.7	33	47	0.7
SOYABEAN	11	9.4	1.2	7	5	1.4
TOBACCO	2,620t	2	1.26	2,337t	2.2	1.07
BEANS (EXCLD. SOYABEAN)	5.4	7.6	0.7	6	17.7	0.4

SOURCE : Agricultural Statistics Bulletin

3) LIVESTOCK FARMING

The Table 2-3-3 shows the number of animals raised in Zambia.

TABLE 2-3-3 THE NUMBERS OF ANIMALS IN ZAMBIA

YEAR	CATTLE 10^3	PIGS 10^3	SHEEP 10^3	GOATS 10^3
1984	2,596	200	73	384
1983	2,436	194	58	369
1982	2,335	188	56	348

SOURCE: Agricultural Statistics Bulletin

As shown in the above table, principal livestock is cattle. Therefore some aspects about cattle will be mentioned hereafter.

The number of cattle by commercial production is about 350 thousands heads. On the other hand 2,250 thousands are raised by traditional african cattle keepers. The consumption of meat in Zambia is about 110 thousand heads per year, 40 per cent of it, is dependent upon imported meat. There are several probrems which make Zambia not achieve self-sufficiency of cattle meat.

Two problems facing cattle production in the traditional sector are failure of

a large proportion of the cows to produce viable calves and high calf mortality before weaning.

Most of the diseases in Zambia can best be controlled by vaccinations. However, failure to carry out these programmes has been due to difficulties in obtaining vaccines from abroad. Local production of vaccines is still limited amount.

The existence of tsetse fly poses a continuous threat to livestock production. The national policy with regard to tsetse control was to consolidate the 1972 holding lines and to eradicate the tsetse fly on the protected side of the line. The present holding lines extend to a total of 1,172 kilometers of which only 260 kilometers are considered to be of standard specifications. The present annual capacity for tsetse eradication, which includes using aerial and ground spraying methods, is 4,428 square kilometers.

The development and extension of artificial insemination is considered to be of great importance in expanding and improving the livestocks of the country. The future of Zambia, as a major producer of livestock products, much in excess in her own requirements, is clearly foreseen.

This future can only be secured by establishing the proper system of a sound animal breeding, utilizing the best genetic material obtainable, both that of the Zambian indigenous cattle and the results of advances in animal breeding elsewhere in the world. This system, however, together with the research system with regard to the exact incidence and distribution of diseases is not still established properly.

CHAPTER 3 PRESENT SITUATIONS OF THE PROJECT AREA

3-1 CLIMATE

The project site is situated in the Lusaka Campus of the University of Zambia, which elevation is about 1,280 meters above the sea level, lying about 15°25' latitude south and 20°18' longitude east.

The mean annual temperature is 19.6°C, the hotest month is October and its mean temperature is 24.2°C. June and July are the coolest months and their mean Temperature is 15.6°C according to the record observed in the station of Lusaka City Airport. It can be said that the variation of Temperature by month is rather small.

On the other hand, as there is a rainy season and a dry season, the relative humidity by month shows quite big differences. The humidity is 85 per cent in February and 41 per cent in April.

The annual precipitation is about 800 mm and 222 mm of rainfall is in January which is the most rainy of the year. The climatic data observed at the above mentioned station

is shown in Table 3-1-1.

Table 3-1-1 CLIMATIC DATA AT LUSAKA..

Months	Pressure (0800)	Thermograph Mean Temperature °C	Mean Max Temperature °C	ABS MAX Temperature °C	Mean of ABS Max Temperature °C	Mean Min Temperature °C	ABS Min Temperature °C	Mean of ABS Min Temperature °C	Dew Point °C	Rel Hum %	Sunshine Hours Per Day	Wind Speed Knots	Rainfall Total mm
No. of Yrs. Available	26	26	26	26	26	26	26	26		26	26	26	26
July	878.0	15.6	22.7	28.3	26.4	9.6	4.4	6.7		54	8.7	7.7	Nil
August	876.4	18.0	25.4	33.9	29.7	11.7	3.9	7.5			9.6	8.5	Nil
September	875.1	21.3	28.9	35.0	33.0	14.7	6.7	10.6		41	9.7	8.9	1
October	873.8	24.2	31.2	37.8	34.9	17.8	10.6	14.2			8.7	7.6	16
November	872.7	22.4	28.7	36.3	33.6	17.8	11.7	14.9		61	6.9	5.7	82
December	872.4	21.1	26.5	33.9	30.8	17.3	12.8	15.3		76	5.5	4.7	194
January	871.9	20.6	25.8	35.0	29.1	17.2	13.9	15.3		82	5.1	4.1	222
February	871.9	20.4	25.8	31.1	28.7	17.1	11.7	15.1		85	5.2	3.7	179
March	873.2	20.2	26.1	32.8	28.8	16.3	11.7	13.4		75	6.9	6.3	88
April	874.7	19.7	26.3	31.7	29.6	14.0	8.0	11.8			8.5	7.2	15
May	876.4	17.6	24.6	29.4	28.2	12.2	7.2	8.9			9.0	7.1	5
June	877,9	15.6	22.8	28.3	26.4	10.2	3.9	6.8		53	8.9	7.8	1
Year	874.5	19.6	26.2	38.3	29.9	14.7	3.9	11.7			7.7	6.6	803

LUSAKA CITY AIRPORT
LAT. 15°25'S LONG. 28°18'E ALT. 1280 M

Source : Climatological Summaries for Zambia

3-2 GROUNDWATER

Many wells can be seen in Lusaka City. Schools and houses utilize groundwater for their domestic use. The result of pumping test made in the Lusaka Campus shows that the yield is 22 liters per second for 8 hours duration.

According to the information given by the Land Use Branch of Ministry of Agriculture & Water Development, the yield from one well is estimated usually to be 10 liters per second for irrigation planning purposes. The depth of well is about 60 meters commonly.

As shown in the next chapter, pumping water needed for this project is to be about 10 litters per second. Considering that the above mentioned pumping test was made at the end of dry season, the quantity of 10 litters per second can be taken throughout the year. Furthermore the electric resistivity survey was carried out by Water Affairs Department of Ministry of Rural Development at the project site. Result shows that underlying rock in the area is fairly decomposed dolomite which contains sufficient groundwater.

3-3 TOPOGRAPHY AND SOILS

The open area at the Lusaka Campus of UNZA between the New Building of Veterinary School and the public road named Kalingalinga Road was proposed to be the construction site of the Veterinary paddock.

The topographic map of this site has been made, which contour line is drawn with the interval of 50 cm. The ground height of this site varies between about 100m and 103m, so that this area is relatively flat and any substantial earth moving work for the paddock construction is not required. Roughly speaking, there is a ridge at the center of the site, rainfall is drained naturally northeastward and southwestward. There are several small hills which will provide moderate undulations and good circumstances for animals.

The area of this site is about 8.2 ha . This area is used illegally as rain-fed agricultural land by the local people.

Fourteen test pits were excavated in the site. According to the observation of the soil profile of one meter in depth, there is no rock and the layer consists of the black top soil followed by the the brown silty clay or highly weathered small stones. The thickness of the top soil is 30mm on an average. The location and result of the test are shown in Fig. 3-3-1 and 3-3-2 respectively.

The PH of the soil was measured. The value of PH was 5.6 for top soil and 7.2 for the soil 10 cm below the surface This soil is defined as saline soil according to the Table 3-3-1. (IRRIGATION PRINCIPLES AND PRACTICES BY O.W. ISRAELSEN)

Saline soils may develop from normal soils through the accumulation of salts by upward moving ground water.

The chemical characteristics of saline soils are determined by the kinds of amounts of salts present which largely control the concentration and osmotic pressure of the soil solution. However the land is used for maize cultivation, the soil

will be easely improved by applying proper amount of calcium carbonate. It is recommended that the value of PH shall be measured and necessary amount of calcium carbonate shall be applied to the soil.

TABLE 3-3-1

CONDITIONS FOR SALINE, SALINE-ALKALI, AND ALKALI SOILS

Salt Condition	Common Term	Salt Index	Sodium Index	Hydrogen Ion Index[1]	Reclamation
		Conductivity of Saturation Extract in Millimhos per Cm	Exchangeable Sodium Percentage	pH	
Saline	White alkali	>4	<15	≦ 8.5	Leaching
Saline-Alkali		>4	>15	generally about 8.5	Leaching necessary and possible, but as salts are removed the sodium must be replaced to prevent dispersion of soil particles and reduction of permeability.
Alkali (Sodic)	Black alkali[2]	<4	>15	generally between 8.5–10.0	Low permeability due to dispersion of soil by the sodium requires replacing the sodium to improve the permeability so that leaching can proceed.

[1] Since a pH of 7.0 is neutral, pH values less than 7.0 indicate an acid soil which is common in the non-arid regions. Note that the larger the pH, the less the concentration of hydrogen ions, since pH is the logarithm of the reciprocal of the hydrogen ion concentration.

[2] A black crust forms on the surface of an alkali soil only if organic matter is present. Hence, the term may be misleading in soils of low organic matter.

Fig. 3-3-1 LOCATION OF TEST PITS

S = 1 : 3,000

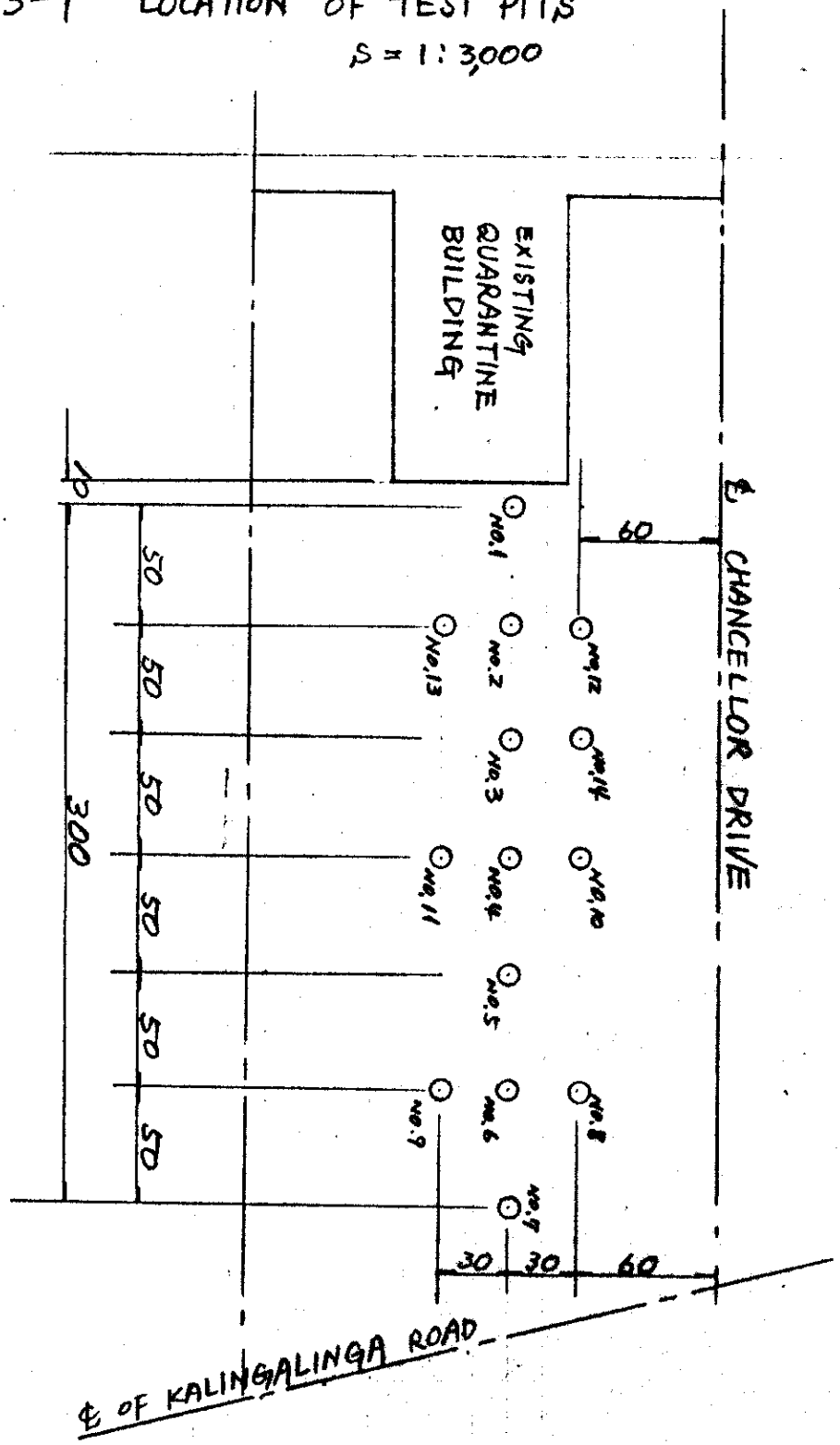
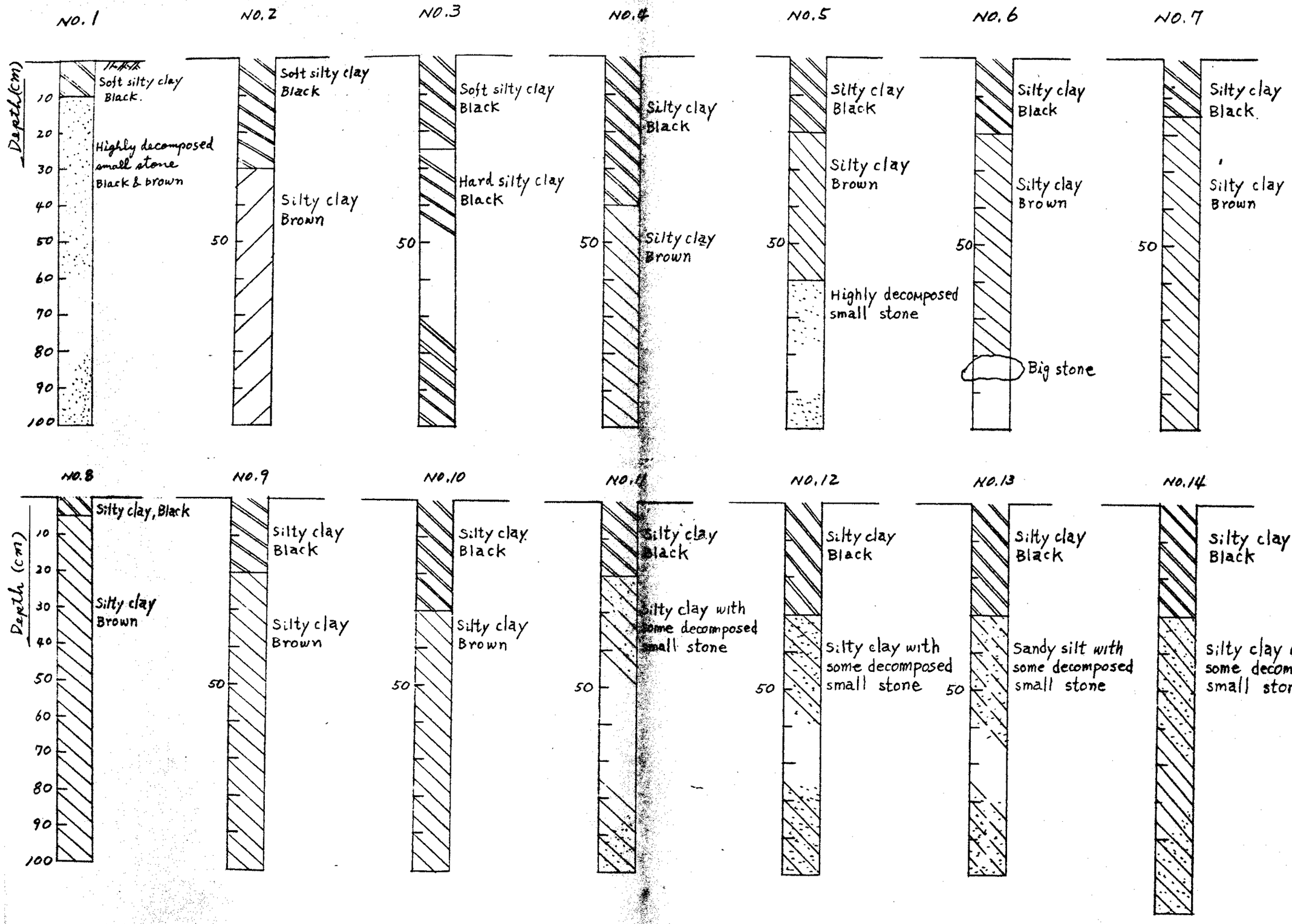


Fig. 3-3-2 PROFILE OF TEST PITS



CHAPTER 4 DETAILED DESIGN OF THE PADDOCK

4-1 GENERAL DESCRIPTION OF THE PLAN

1) The policy of the detailed design

Followings are the items confirmed by Professors and the personnel concerned of the University, at the meeting held on 18th Oct, 1985.

1) The priority order on the purpose's of the veterinary paddock should be made as follows;

No. 1 To keep animals for experimental uses
No. 2 To observe sequencial development of diseases,
No. 3 To provide handlings area for the educational purposes

2) Total area shall be surrounded by the tall concrete block wall to prevent a burglary effectively.

3) The animals to be kept, would be cattle, sheep, goat and horse, mainly large and small grazers. They are kept easily with some hay supplement. Because of traditional requirement, at least one paddock should be allocated for horses. Special fencing must be considered for the paddock of horse. Barbed wire fence will not be used for it.

4) The area shall be divided into seven paddocks to raise different kind of animals.

5) Minimizing the cost of purchase of feedstuff, the production of grass should be made as much as possible, accordingly the paddocks have to be irrigated to realize the ideal production of grass.

6) The shade trees should be planted in each paddocks to provide animals good circumstances. However, at least 6 years would be required for trees to grow. In the mean time, simple huts are essential.

7) Regarding holding capacity of the pasture, one cattle per acre is preferable based on the western standard. Subsequently, 16 heads of cattle or 70 heads of sheep could be kept in this paddock. (Regarding these numbers review will be made in 4-2-1).

8) The advantage to use spray-race instead of dip, was suggested. The to have weighing machine for animals was also pointed out.

Taking the above mentioned items into considerations, the investigation and the design for the construction of the veterinary paddock has been performed.

2) Outline of the plan

(1) The total area shall be divided into seven paddocks. Each paddock has following areas.

Padock	area (ha)
NO. 1	0.546
NO. 2	0.560
NO. 3	1.120
NO. 4	0.780
NO. 5	1.155
NO. 6	1.155
NO. 7	0.874
Total	6.19

(2) These paddocks shall be surrounded by the tall concrete block wall. The height of it is to be 2.5 and 2.0 meters at Kalingalinga Road side and other side respectively.

(3) Handling area is proposed to be made beside the Chancellor Drive to be extended. Its area is about 0.4 ha and following facilities shall be installed in it.

a. Corral

This is surrounded by the wooden fence and divided into four chambers which are connected through the gates of each other. They are systematically arranged to realize the ideal handling and treatment of animals.
A loading ramp is to be constructed and connected to the one of the chambers. A spray race as well as a crush is to be installed in the corral. Each chamber has an area of about 80M^2. The floor of the chamber is paved with concrete.

b. Spray Race

A small hut made of concrete block is to be built, which size is to be about $5M^2$. The spray race defined all steel portable cattle race is to be installed in this hut.

c. Crush

The crush is to be installed on the concrete base. Weighing, branding, dosing and mouthing are the purpose of the crush installation. This is made of steel entirely.

d. Hay stock
e. Handling shed
f. Loading ramp
g. Storage
h. Water trough
i. Reservoir and pump station
The size of reservoir is 15m x 15m and the volume of stored water is $225m^3$.
Therefore the irrigation pumps can be operated for about 6 hours without water supply from the well. This relatively large reservoir can absorb any differences between the quantity of water supply and that of consumptive use.
This is made of reinforced concrete.

Two sets of irrigation pumps are to be installed in the pump station. Both pumps have the capacity of 7.5KVA respectively. The pumps are to be operated for about 13hours per day during the dry season.

(4) Sewen padocks are divided with barbed wire fence each other. As the paddock no. 7 is for horses, wooden fence shall be installed instead of barbed wire fence.

(5) Drainage canal

Unlined drainage canal is to be made along the Chancellor Drive to be extended and connected to the existing canal. The concrete canal shall be made along the concrete block wall and basin and drain pipe shall be installed each 50 meters.

(6) Deep well

The electric resistivity survey has been made at the proposed site. The result shows that enough yield can be expected for this project. Irrigation water is to be pumped up by 11 KVA submersible pump installed in the casing of 150 mm in diameter as stated in the section 4-2-5). As the power supply is to be arranged by the University, only the cost of the short distance connection is estimated for the construction cost.

The water pumped up from the well is reserved in the reservoir. It is pressed by two centrifugal pumps and conveyed to the field.

(7) Irrigation pipe-line

As shown in Drawing NO.1, irrigation pipes are to be installed, which diameter is 125 mm and 100 mm. The depth of the pipe from the surface shall be at least 50 cm and they are laid up a slight gradient of 2 per cent to every hydrant.

A drain valve shall be installed at the lowest point of the pipe line, near pump house.

8) Land clearing, plowing, harrowing and sowing.

Small stones and waste materials of the construction are scattered in places. They are to be removed. The plowing, harrowing followed by sowing are the necessary work items. At the same time, nutrient deficiencies should be rectified before planting. It is normally recommended to apply 800kg "A" or "V" compound plus 20kg solubar per hectare. It is recommended to test nutrient deficincies through the chemical analysis by the time of construction.

(9) Others

a steriliging basin is proposed, which is to be installed at the side of the main entrance gate. A manure stock shed is also proposed to be constructed near the holding shed.

4-2 DETAILED DESIGN OF THE PADDOCK

1) Land use plan

a. Holding capacity of the paddock

In general the number of cattle which is necessary for the veterinary education should be estimated after establishing the concrete plan of education. Accordingly the necessary area can be determined. The area of the proposed site, however, is limited. The net area of seven paddocks is to be estimated 6.2 ha. 16 heads are the maximum holding capacity according to the decision of the University meeting. However this

number seemed to be excessive and 12 heads are proposed based on the following reason.

The land use plan is established considering that the cattle is raised by means of pasturage. As the self-sufficiency of feedstaff is aimed in principle in this paddock, as much as grass should be produced through the proper administration of the grass land. Accordingly additional fertilizer is essential by the amount of 50 kg/ha of N and K_2O respectively once a month. Under these conditions, the target of the production of grass is estimated to be 60 t/ha·year. On the other hand, one cattle eats grass by 50 kg per day on an average. And the ratio of utilization of the paddock is assumed to be 60 per cent, the holding capacity per one hectare is calculated as follows;

$$\frac{60{,}000\ \text{kg/ha} \times 0.6 \times 1\ \text{ha}}{365\ \text{day} \times 50\ \text{kg}} = 2\ \text{heads/ha}.$$

Nevertheless, above mentioned target shall be achieved only at the grassland, not at the pasturage land. All grass growing

in the pasturage land can not be eaten by the cattle considering their behavior. Therefore grazing of 12 cattle in this paddock seems to be too hard. It is recommended that extra grassland should be secured outside the proposed site for safety.

b. The handling area is proposed at the center of north east side of the site. This area is convinient to handle cattle which are brought in the site. A deep well is proposed in this area.

c. The total area is to be a moderate paddock without any substantial earth moving work except in the handling area.

2) Operation and maintenance of the pasturage land.

The fixed pasturage is the aim for the proposed paddock. Following items should be taken into considerations for the purpose of operation and maintenance.

a) The kind of grass sown in the paddock shall be determined by the University. Whichever grass may be selected, the spots where there is no grass will appear in the course of time. In this case they are plowed again by the tooth harrow and additional sowing are required. After sowing and trampling down by cattle, they are to be remained for about 4 weeks without any

cattle.

b) The paddock will be sparsely dotted with grass after several years. To prevent this leguminous plants is recommended to be mixed and sown in advance.

c) The barbed wire fence will be durable for several years. However leguminous trees named Lukina are recommended to be sown along the fence. They are eatable and will be a hedge after their growth.

d) The total area is to be divided into 7 paddocks. Each paddock should be divided into 3 areas. They are to be used as small rotational fields for the efficient use of the paddock.

e) Manure shall be made using the waste from the holding sheds. It is to be spread in the paddock.

3) Drainage plan

As mentioned in 3-3, there is a dividing ridge at the center of the site. Therefore rainfall is draind north east and south westward. The drain water to north east side is caught into the concrete lining canal maid along the access road and drained through concrete pipes (ϕ200) installed each 50 meters of the said canal.

The main drain canal is unlined and proposed along the Chancellor Drive to be extended by the University. This is to be connected with the existing drain canal and water from the site shall be conveyed to the existing pond through the canal

As there is no future development plan for the south west side of the site. So that rainfall is drained naturally as it is to the adjacent area.

The size of the drainage facilities is determined based on the following standard.

a Discharge ($Q\ m^3/sec$)

$$Q = \frac{1}{360} \times f \times \gamma_t \times A$$

where f : Runoff coefficient (0.5)

r_t : Average intensity of rainfall within the arriving time (mm/hr)

A : Area of watershed (ha)

b. Intensity of rainfall

As there is no proper rainfall data, 80 mm/hr for 10 minutes arriving time is assumed.

c. Area of watershed

4.1 ha (main drain canal)

0.4 ha (concrete canal and drain pipe)

4) Road plan

The entrance gate is to be made at the northwestern side of the site, from this gate access road of 6 meters in width is to be constructed. This road shall be latelite paved. This is used for the traffic road of the farming equipment as well as the circuit of the rotational use of the paddock.

The lateral road is proposed from the main road to the paddock NO. 2, which width is 3 meters. (Refer Drawing NO. 1.)

5) Irrigation plan

a. Consumptive use of water

Following table shows the climatic data in Lusaka. Two estimations are made based on the data.

Table 4-2-1 CLIMATIC DATA IN LUSAKA

	May	June	July	Aug.	Sep.	Oct.	
TEMP MEAN DAY °C	17.6	15.6	15.6	18.0	21.3	24.2	CLIMATOLOGICAL SUMMARIES
PRECIPITATION mm	5	1	0	0	1	16	CLIMATOLOGICAL SUMMARIES
PAN EVAPORATION mm	6.5	6.0	6.7	8.5	10.0	12.6	PAN EVAP. IN ZAMBIA 1959-68 MEAN
WIND SPEED m/sec	3.7	4.0	4.0	4.4	4.6	3.8	CLIMATOLOGICAL SUMMARIES
REL. HUM. %		53	54		41		"

① Pan evaporation method

Refering guidelines for predicting crop water requirements (FAO), estimation is made as follows;

$$ET_o = K_p \cdot E_{pan}$$

where ET_o = reference crop evapotranspiration (mm)

K_p = pan coefficient

E_{pan} = pan evaporation in mm/day and represents the mean daily value of the period considered

According to Table 4-2-1, Pan evaporation is the largest in October. Therefore calculation

is made for this month. Relative humidity is estimated to be low or medium. As it is the end of dry season, there is no green grass around the pan. Considering that the wind velocity is moderate, Kp is calculated to be 0.5 based on the said book.

$$\therefore ET_o = 0.5 \times 12.6 = 6.3 \text{ mm/day}$$

On the other hand, the relation between ETo and crop evapotranspiration (ETcrop) is given below:

$$ET_{crop} = K_c \cdot ET_o$$

where K_c = crop coefficient

Kc value is variable from crop to crop and from growth stage to stage, however, in case of grass Kc = 1 can be selected for the practical purpose.

Accordingly crop evapotranspiration (ETcrop) is determined to be 6.3 mm/day.

② Blaney-Criddle method

This method is suggested for areas where available climatic data cover air temperature data only. The relationship recommended, representing mean value over the given month,

is expressed as:

$$ET_o = c\,[p(0.46T + 8)] \quad mm/day$$

where ET_o = reference crop evaporation in mm/day

T = mean daily temperature in °C

p = mean daily percentage of total annual daytime hours

c = adjustment factor which depends on minimum relative humidity, sunshine hours and daytime wind estimates

Calculation is made according to the said book. As the result ET_o value is obtained as 6.3 mm/day. This value can be decreased by 10 per cent every one thousand meters of elevation from the sea level. Although the elevation of the site is more than 1,000 meters, this is to be ignored and crop evapotranspiration is decided as 6.3 mm/day finally.

b) Water resource

There is no surface water around the project site. On the other hand the result of electric resistivity survey shows that there is abundant groundwater at the site. The yield of 20 ℓ/sec can be expected according to the pumping test made in the campus.

Therefore a deep well construction is proposed, which depth is estimated to be 60 m from the ground level.

c) Irrigation method

As the proposed site is relatively flat and this area will be developed as a pasturage land, sprinkler irrigation is recommendable instead of surface irrigation such as furrow and flooding irrigation. Irrigation pipe line shall be installed under the ground. movable sprinklers will be connected with riser pipe fixed to the line.

d) Plan of irrigation

① available moisture

The depth of root zone is assumed to be 40 cm based on the field observation. The total readily available moisture (TRAM) can be calculated as shown in Table 4-2-2.

Table 4-2-2 CALCULATION OF TRAM

NO. OF SOIL LAYER	DEPTH OF LAYER (cm)	% OF USE OF WATER	AVAILABLE MOISTURE (mm) *	USE OF WATER FROM EACH LAYER BASED ON EXTRACTION PATTERN (mm)	RESTRICTING LAYER	TRAM (mm)	USE OF WATER BY LAYER (mm)
NO. 1	0~10	40	17.0	42.50	0	42.50	17.00
NO. 2	10~20	30	17.0	56.67			12.75
NO. 3	20~30	20	17.0	85.00			8.50
NO. 4	30~40	10	17.0	170.00			4.25
TOTAL			68.0				42.50

* Available moisture is quoted from 「PLAN AND DESIGN OF FIELD IRRIGATION JAPAN」. Soil type is assumed to be loam.

② Irrigation interval : D

$$D = \frac{TRAM \quad (mm)}{\text{peak daily consumptive use of water } (mm/day)}$$

$$= \frac{42.5}{6.3} \fallingdotseq 6 (day)$$

③ Efficiencies of irrigation

The water application efficiency (Ea) and conveyance efficiency (Ec) are assumed 85% and 5% respectively. Accordingly Irrigation efficiency is found to be 80%.

④ Irrigation water

- Net irrigation water

maximum irrigation water × irrig. interval

6.3 mm × 6 days = 37.8 mm

Gross irrigation water

Net irrig. water ÷ Efficiency

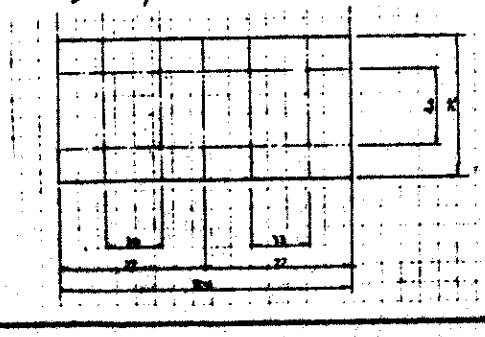
37.8 mm ÷ 0.8 = 47.3 mm

e) Irrigation facilities

① Layout of sprinkler

As paddock NO.1 and NO.2 are relatively small, they are irrigated in a day, but for other five paddocks, each one of them will be irrigated in a day respectively.

The layout of sprinkler is shown below. Two sets of sprinkler are moved four times a day to irrigate one standard paddock.



unit : meter

② Capacity of sprinkler

$$q = \frac{D \cdot SL \cdot SM}{60 \cdot T}$$

where D = depth of irrig. water (mm)

SL = distance of sprinkler (m)

SM = distance of lines (m)

T = irrigation hour per one point (hr)

$$q = \frac{47.3 \times 30 \times 40}{60 \times 3.75} = 252 \text{ l/min.}$$

Sprinkler must be selected from the actual manufactures. Following type is selected for this plan.

TS-105 NO (diameter of noggle 14×7.2×4.8)

Working pressure 4.0 kg/cm²

Capacity 298 l/min

Diameter of sprinkling 60.5 m

③ Intensity of sprinkling

$$I = \frac{60 \cdot q}{A}$$

where I = intensity (mm/hr)

q = capacity of sprinkler (l/min)

A = SL × SM (m²)

$$\therefore I = \frac{60 \times 298}{40 \times 30} = 14.9 \text{ mm/hr}$$

④ Actual irrigation hour per one movement

T_o = net irrigation water ÷ Ea ÷ Intensity

= 37.8 (mm/day) ÷ 0.85 ÷ 14.9 (mm/hr)

= 2.99 hr

⑤ Actual irrigation hour per day

$$T = T_o \times S$$

where S = numbers of movement per day

$$T = 2.99 \text{ hr} \times 4 = 12 \text{ hr/day}$$

⑥ Capacity of irrigation pump

Two sets of pressure pump are to be installed to convey irrigation water. The discharge of these pumps is found as follows;

$$Q_{max} = q_o \times n \times (1+E_c) \times \frac{1}{2}$$

where Q_{max} = discharge of pump (ℓ/min)

q_o = capacity of sprinkler (ℓ/min)

n = the number of sprinkler

E_c = conveyance efficiency

$$Q_{max} = 298 \times 2 \times (1+0.05) \times \frac{1}{2}$$

$$= 313 \text{ ℓ/min}$$

The capacity of pump is found by applying following equation.

$$P = \frac{0.163 \times \gamma \times Q \times H}{\eta_p \times 0.01}$$

where γ = specific gravity of water = 1.0

Q = discharge m^3/min

H = total head (m)

η_p = efficiency (%)

$$\therefore P = \frac{0.163 \times 1 \times 0.313 \times 49.6}{0.45}$$

$$= 5.6 \text{ KW}$$

6) Design of reservoir

The pumping volume from the well is slightly larger than the conveyance volume by two irrigation pumps. Therefore the reservoir is not necessary theoretically for this irrigation plan. A simple and durable system, however, is strongly necessitated to minimize the operation and maintenance cost. The large volume of reserved water results in the smooth operation of water conveyance, even if some trouble will happen in pumping from the well. In this respect larger reservoir is recommendable. As the result the volume of reservoir is proposed to be 225 m^3, this volume is equivalent to that of irrigation water for about six hours.

4-3 CONSTRUCTION PLAN

1) Outline of the construction

The construction items and amount are shown in Table 4-3-1.

No.

Table 4-3-1 BILL OF QUANTITIES

ITEM	UNIT	QUANTITIES	NOTE
1. LAND GRADING	ha	1.4	
2. ROAD			
MAIN ROAD PAVED WITH LATERITE	m	374	W = 6 m
BRANCH ROAD "	"	120	W = 3 m
3. DRAIN WORK			
UNLINED DRAIN CANAL	"	487	
CONCRETE CANAL	"	474	INCLUD. BASIN & DRAIN PIPE
4. PLOWING, HARROWING & SOWING	ha	6.19	
5. CONCRETE BLOCK WALL			
TYPE I	m	174.5	H = 2.5
TYPE II	"	1,439	H = 2.0
6. BARBED WIRE FENCE	"	1,042	H = 1.3
7. WOODEN FENCE	"	191	
8. IRRIGATION FACILITIES			
INSTALLATION OF PVC PIPE φ125	m	504	
" " φ100	"	355	
HYDRANT	LS	1	
WELL	"	1	CASING φ150 DEPTH 60 m
RESERVOIR	EACH	1	15 m x 15 m x 1.3 m
PUMP HOUSE	"	1	3.8 m x 3.4 m

No.

ITEM	UNIT	QUANTITIES	NOTE
9. CORRAL			
WOODEN FENCE	m	158	H = 1.6m
CRUSH	LS	1	WEIGHT MAX 1 TON
SPRAY RACE	"	1	INCLUD. HOUSE & TANK.
STEEL GATE TYPE II	each	5	3.0×1.4 steel pipe
WOODEN GATE TYPE IV	"	4	1.0×1.6 m
LOADING RAMP	LS	1	MADE OF CONCRETE BLOCK
FLOOR OF CORRAL	m^2	348.8	T = 0.1 m
10. HAY STOCK	each	1	4.0×10.0 m
11. HOLDING SHED	"	1	
12. MISCELLANEOUS			
STORAGE	"	1	2.4×4.4 m
WATER TROUGH	each	6	2.0×1.0 m
SHADE TREE	"	50	FLAME TREE OR MANGO
SHADE SHED	"	7	3.0×2.5 m
MANURE STOCK	"	1	1.8×1.8 m
STERILIZING BASIN	"	1	1.0×0.5 m
STEEL GATE TYPE I	"	2	6.0×1.4 m
" " TYPE III	"	10	2.0×1.4 m
DRAIN BASIN	"	1	1.5×1.5 m

NOTE. Following materials and equipments shall be supplied by JICA.

1. Sprinkler 2 sets
2. PVC Pipe φ125 : 595m φ100 : 302m
3. Submersible pump 11 KVA 1 Set
4. Centrifugal pump 7.5 KVA 2 Sets

2) Conditions of the cost estimation

As mentioned in 2-2, the increase of the commodity price is so remarkable that the prices investigated in November 1985 seem to be on the rise. With regard to cement and wood, the manufacturers have already announced to increase their prices from January 1986 about 30 per cent. Therefore the contingency reserve is essential in this estimation.

The costs for implementation of the project are estimated on the basis of the detailed design, taking into account the construction method to be applied, productivity of labour and machinery and also based on the following assumptions:

(1) The exchange rate used in the estimate is:

1 US$ = K 6.00 = ¥ 210-

(2) Land acquisition cost is not involved.

(3) physical contingencies related to the construction quantities and price contingency, 10 % of the direct construction cost, are included.

(4) The prices used in the estimation are as follows:

a. Labour cost

Foreman	K. 30.00/day
Skillful labourer	K. 28.00/day
Common labourer	K. 25.00/day

b. Material cost at construction site

Sand		K 82.5/m³
Crushed stone		K. 104.50/m³
Cement		K. 260 - /ton
Concrete block	200×150×400	K. 1.70/each
"	200×200×400	K. 2.00/each
Barbed wire		K. 1.50/m
Timber		K. 793.00/m³
Log	φ100~150 ℓ=2.1m	K. 20.00/each
Reinforcing bar	D13	K. 4480.00/ton

c. Machinery cost including operator and fuel

Bulldozer	11t	K. 390/hr
Back hoe	0.4m³	K. 351/hr
Truck	4T	K. 127/hr
Motor grader	W=3.1m	K. 369/hr
Tire roller	6~8t	K. 220/hr

3) Construction schedule

The construction period is estimated to be five months as shown in Table 4-3-2.

Table 4-3-2 CONSTRUCTION SCHEDULE

Work items	month					
	1 ST	2 nd	3 rd	4 th	5 th	6 th
PROCEDURE OF TENDER	———					
PREPARATION		———				
LAND GRADING		———	———			
ROAD				———	———	
DRAIN WORK				———	———	
PLOWING, HARROWING AND SOWING			———			———
CONCRETE BLOCK WALL		———	———	———	———	
BARBED WIRE FENCE		———	———	———		
WOODEN FENCE		———	———	———		
IRRIGATION FACILITIES			———	———	———	———
CORRAL				———	———	
HAY STOCK				———		
HOLDING AREA				———	———	———
MISCELLANEOUS				———	———	———
CLEARANCE WORK						———

REPUBLIC OF ZAMBIA

ATTACHED DRAWINGS

FOR

CONSTRUCTION OF
THE VETERINARY PADDOCK
VETERINARY EDUCATION PROJECT

JANUARY , 1986

JAPAN INTERNATIONL COOPERATION AGENCY

INDEX OF DRAWINGS

DWG. NO	TITLE	PAGE
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4	TYPICAL SECTION OF CHANCELLOR DRIVE & ACCESS ROAD	
5	TYPICAL SECTION OF ACCESS ROAD	
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14	DTAILS OF HOLDING SHED	
15	DTAILS OF STORAGE	
16	DTAILS OF RESERVOIR	
17	DTAILS OF LOADING RAMP	
18	DTAILS OF MANURE STOCK	
19	DTAILS OF WATER TROUGH & STERILIZING BASIN	
20	INSTALLATION OF PUMP & PUMP HOUSE	
21	DTAILS OF SPRINKLER	
22	PIPING PLAN & FITTINGS NO 1	
23	PIPING PLAN FITTINGS NO 2	
24	PIPING PLAN FITTINGS NO 3	

GENERAL PLAN OF THE VETERINARY PADDOCK

SCALE 1:1000

N

494.00
487.00
474.00
140.00
224.00
75.00
75.00
75.00
75.00
34.00
150.00

CHANCELLOR DRIVE (UNDER CONSTRUCTION)

EL=99.20

GATE (TYPE I)

ACCESS ROAD
BARBED WIRE FENCE

ROAD W= 6.00 (TYPE I) L=224.00

DRAIN PIPE HP ø 200 L=484.00

DRAIN CANAL

HANDLING AREA

CONCRETE BLOCK WALL H= 2.00 (TYPE 2) L=474.00

GATE (TYPE I)

ROAD W= 6.00 (TYPE I) L=150.00

PADDOCK 1 (A=9460m²)

VP ø 100 L=71.00

VP ø 125 L=286.00

VP ø 125 L=70.00

ø75 L=58.00

BARBED WIRE FENCE

ø75 L=61.00

VP ø 125 L=121.50

ø75 L=79.00

ø75 L=61.00

ø75 L=59.00

VP ø 125 L=150.00

SCHOOL OF VETERINARY MEDICINE

EXISTING QUARANTINE BUILDING

PADDOCK 3 (A=11200m²)

VP ø 125 L=117.00

VP ø 125 L=62.00

PADDOCK 5 (A=11550m²)

VP ø 100 L=62.00

PADDOCK 6 (A=11550m²)

WOODEN FENCE L=150.00

VP ø 100 L=59.00

PADDOCK 7 (A=8740m²)

ROAD W= 3.00 (TYPE II) L=120.00

PADDOCK 4 (A=7850m²)

VP ø 125 L=59.00

ø75 L=61.00

ø75 L=59.00

WATER TROUGH

CONCRETE BLOCK WALL H= 2.00 (TYPE 1) L=116.50

ø75 L=75.00

VP ø 100 L=71.00

ø75 L=71.00

PADDOCK 2 (A=5600m²)

BARBED WIRE FENCE

GATE (TYPE II)

CONCRETE BLOCK WALL H= 2.00 (TYPE 2) L=959.00

BOUNDARY LINE OF THE PROPERTY SITE

140.00
75.00
75.00
75.00
75.00
88.00
900
525.00
504.00

① - ①'

El.1=100.7m

1.20m

El.2=99.50m

El.=99.50m

② - ②'

El.1=100.8m

1.22m

El.2=99.63m

③ - ③'

El.1=100.7m

0.87m

El.2=99.83m

④ - ④'

El.1=100.45m

0.90m

El.2=99.87m

⑤ - ⑤'

El.1=100.40m

0.87m

El.2=99.78m

PROJECT	UNIVERSITY OF ZAMBIA VETERINARY EDUCATION PRO.
TYTLE	GENERAL PLAN OF THE VETERINARY PADDOCK
SCALE	NO 1
DATE	
DESIGNED	

TOPOGRAPHIC MAP OF THE PROPOSED SITE

INTERVAL OF CONTOUR LINE : 0.50 M

S = 1/1000

N

+6 +4 +2 ±0 -2 -4

BM-1

BM-2

THE PROPOSED SITE

EXISTING QUARANTINE BUILDING

BOUNDARY LINE OF THE PROPOSED SITE

$\Sigma A = 8.810^{ha}$

PROJECT	
TYTLE	TOPOGRAPHIC MAP OF THE PROPOSED SITE
SCALE	NO 2
DATE	
DESIGNED	

PLAN OF HANDLING AREA

SCALE 1:200

Concrete Block Wall

Gate

Barbed wire fence

Reservoir
V = 15.0m x 12.0m x 1.3m (1.0m)
= 225.0m³

Pump House

Shade Trees

Stooge

Hay stock

Holding sheds

Irrigation Pipe dp # 125

Stop Valve

Barbed wire fence

Gate (Type I)

Spray Race

Loading Ramp

Gate (Type IV)

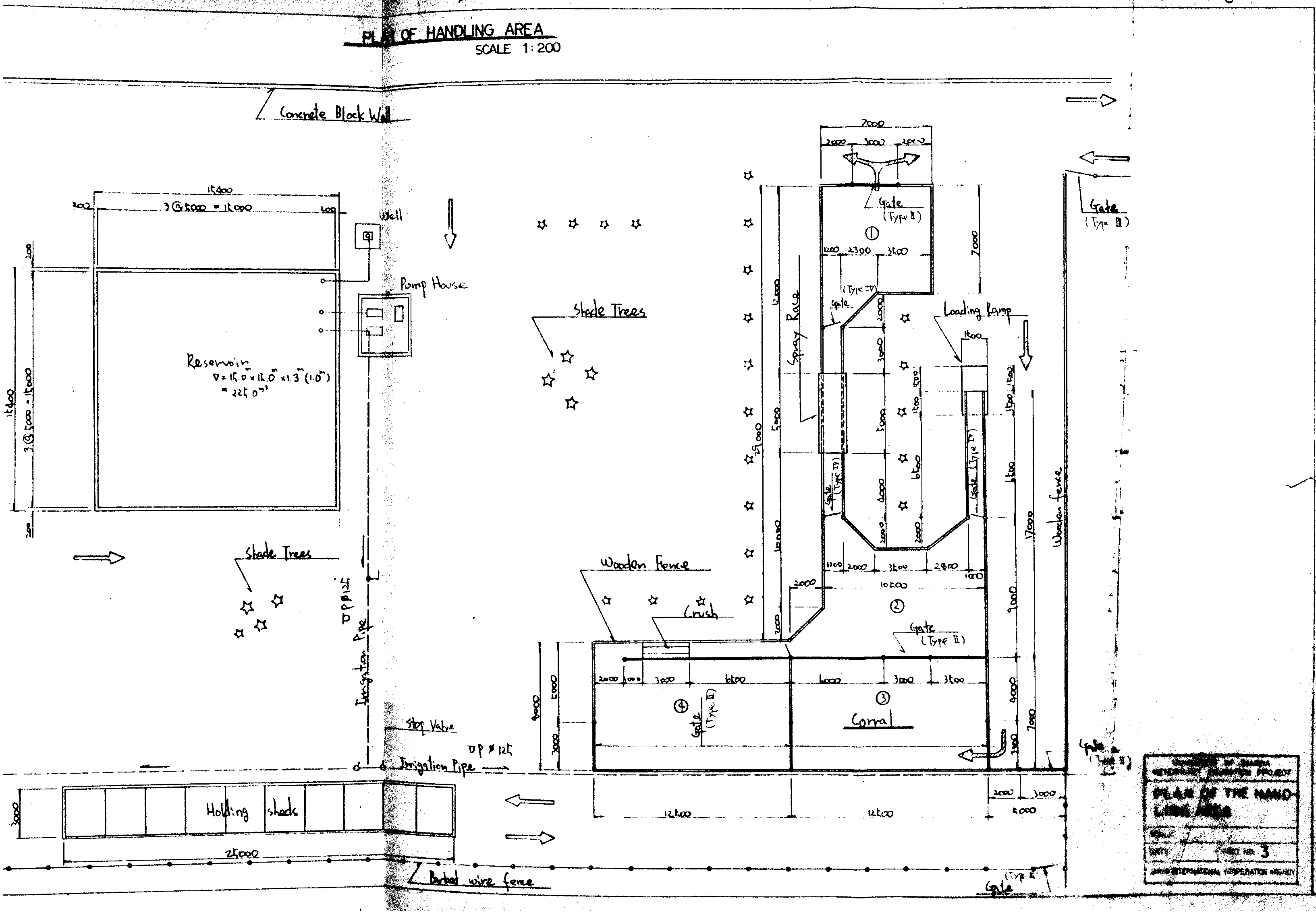
Gate (Type III)

Wooden Fence

Crush

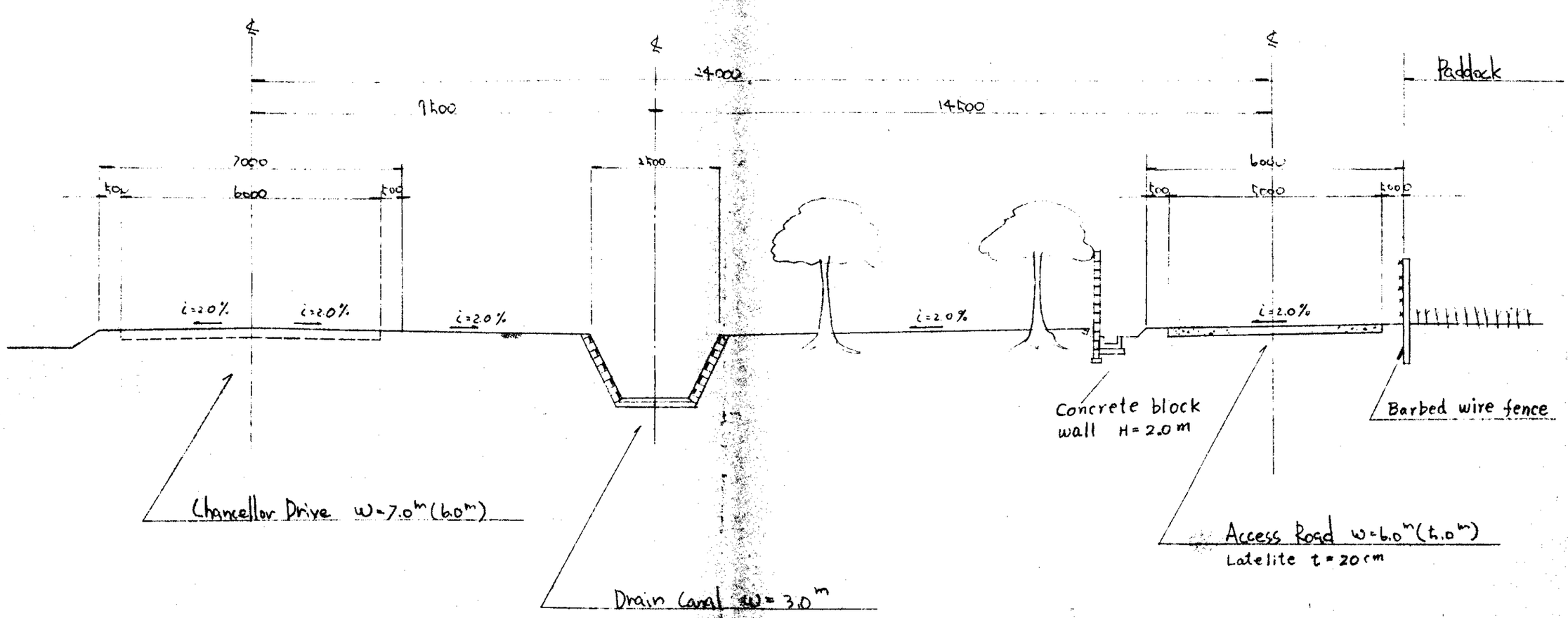
Gate (Type II)

Corral


PLAN OF HANDLING AREA
SCALE 1:200
Concrete Block Wall
Well
Pump House
Reservoir
∇ = 15.0m × 15.0m × 1.3m (1.0m) = 225.0m³
15400
3 @ 5000 = 15,000
Shade Trees
Shade Trees
Irrigation Pipe
VP ø 125
Stop Valve
Irrigation Pipe
VP ø 125
Holding sheds
25,000
Barbed wire fence
Wooden Fence
Crush
Spray Race
Gate (Type II)
Gate (Type IV)
Loading Ramp
Wooden fence
Corral
Gate (Type II)
29,000
17000
12600
12600
10600
6000

A - A Section

scale 1:100



UNIVERSITY OF ZAMBIA
VETERINARY EDUCATION PROJECT

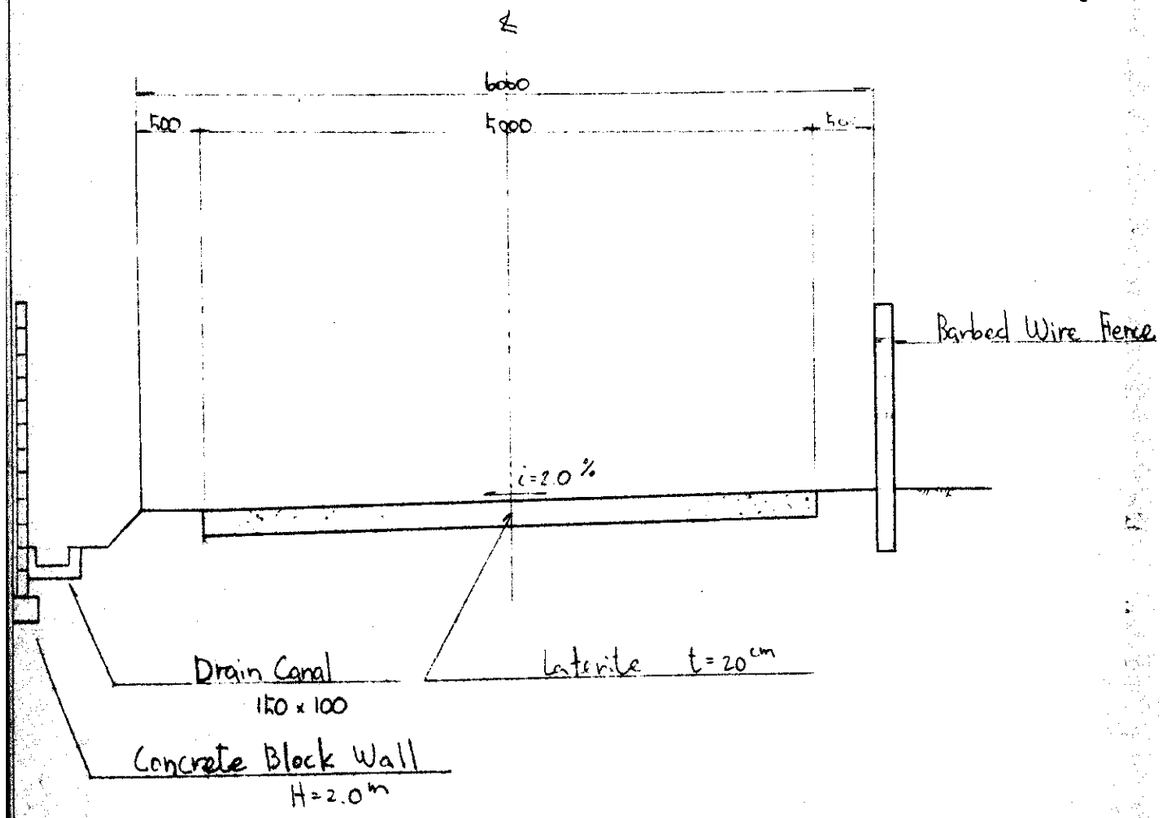
TYPICAL SECTION OF CHANCELLOR DRIVE & ACCESS ROAD

4

ROAD (Type I)

Scale 1:10

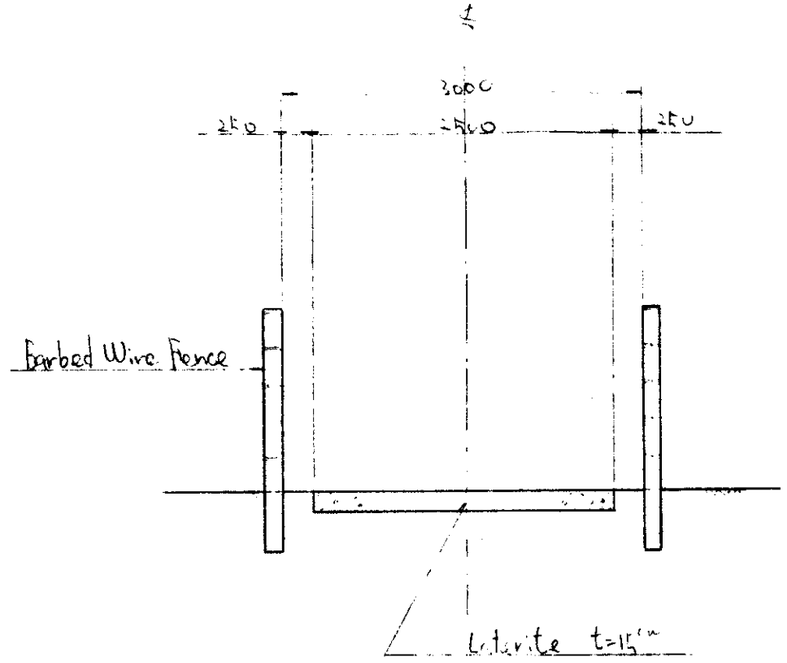
W = 6.0 m (5.0)



ROAD (Type II)

Scale 1:10

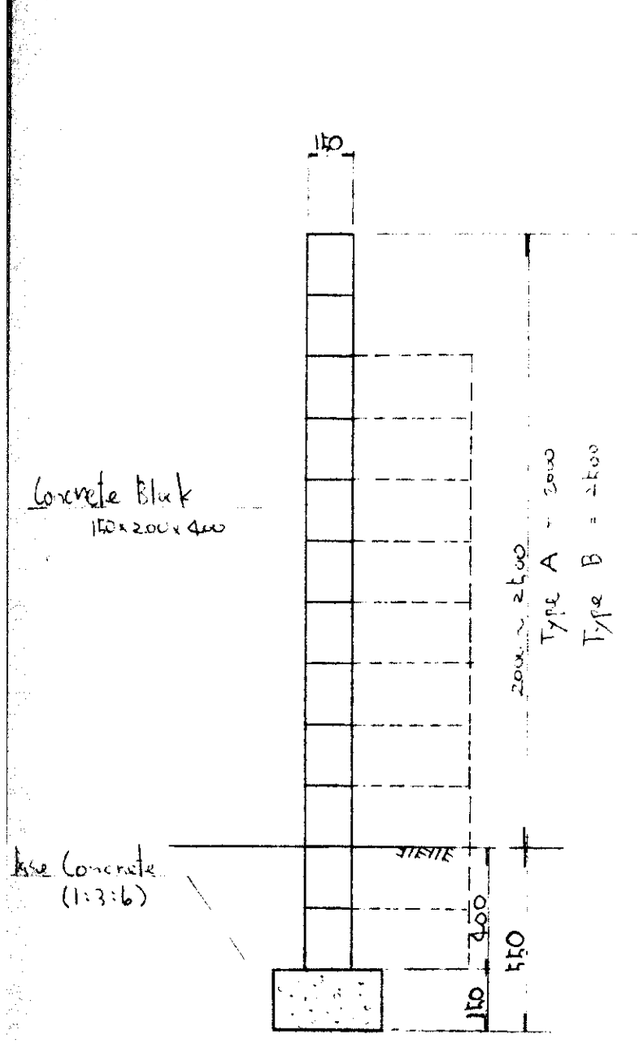
W = 3.0 m (2.5)



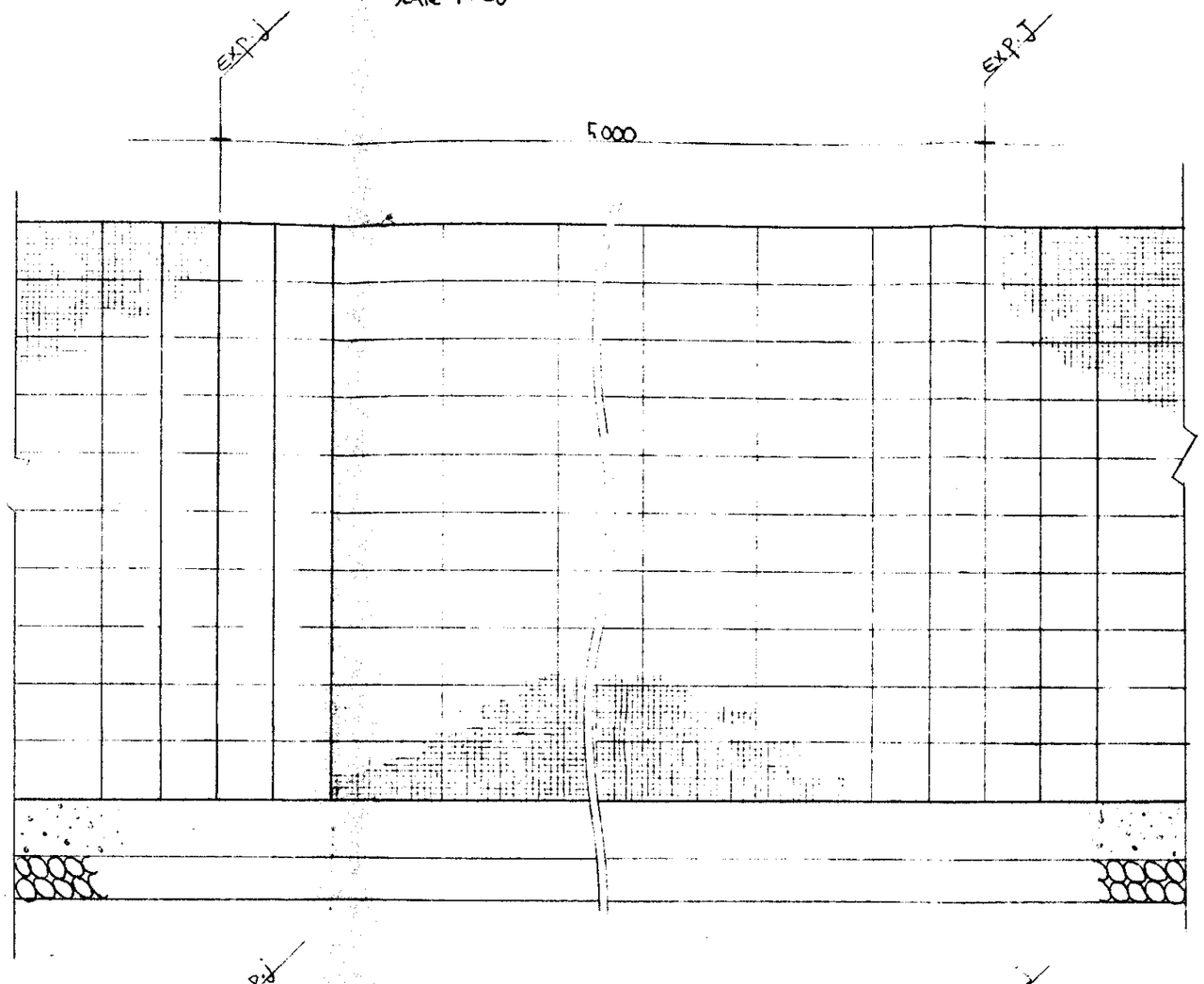
UNIVERSITY OF ZAMBIA VETERINARY EDUCATION PROJECT	
TYPICAL SECTION OF ACCESS ROAD	
SCALE:	
DATE:	DRAWING NO. 5
JAPAN INTERNATIONAL COOPERATION AGENCY	

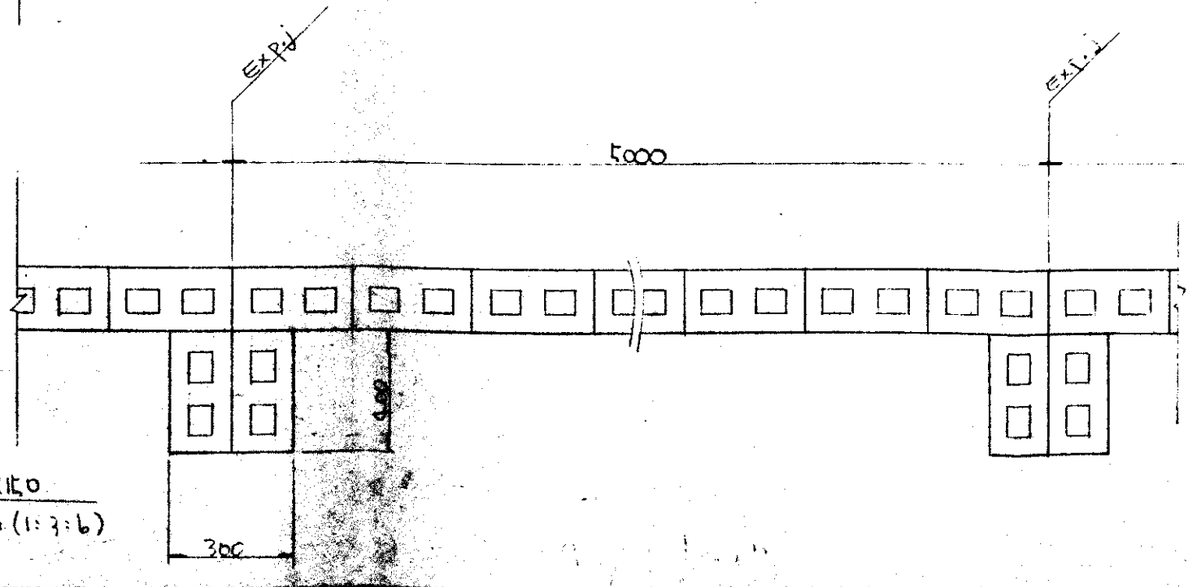
Concrete Block Wall

scale 1:20

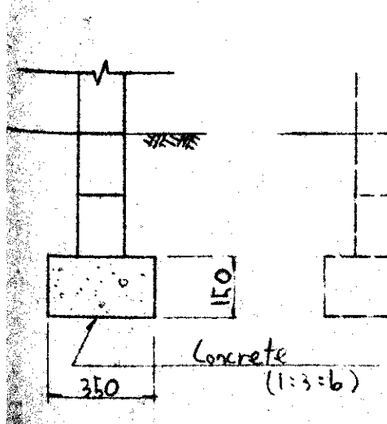


Concrete Blok
150 x 200 x 400

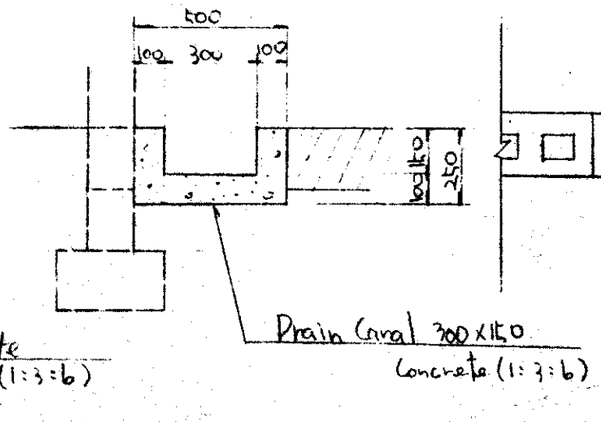




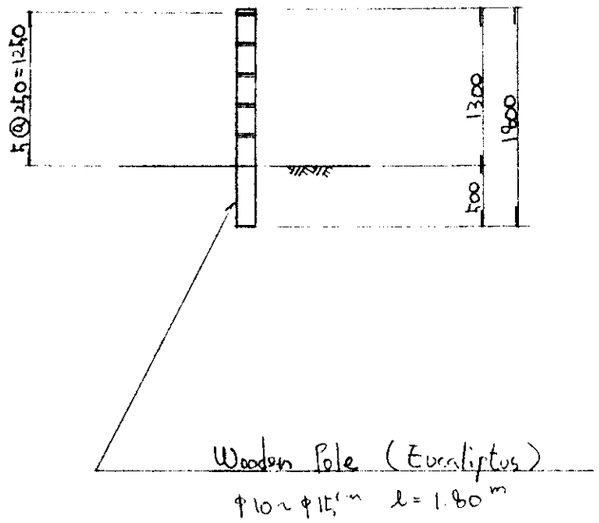
Foundation treatment

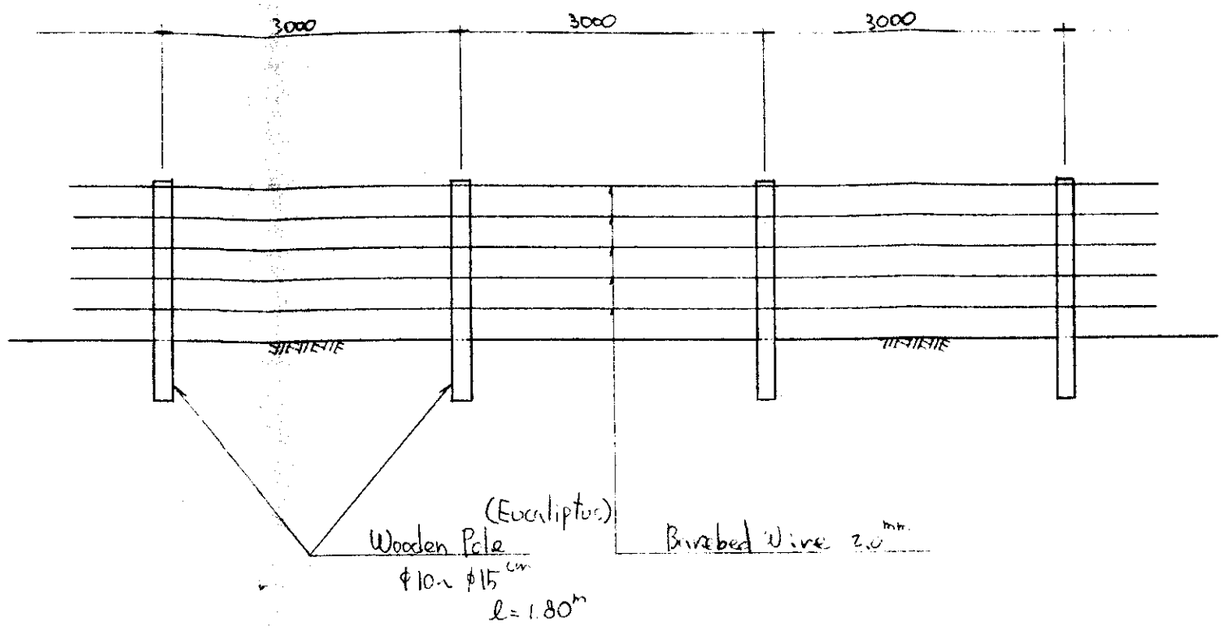


Drain Canal



UNIVERSITY OF ZAMBIA VETERINARY EDUCATION PROJECT	
DETAILS OF CONCRETE BLOCK WALL	
SCALE:	
DATE:	DRG. NO. 6
JAPAN INTERNATIONAL COOPERATION AGENCY	





UNIVERSITY OF ZAMBIA
VETERINARY EDUCATION PROJECT

DETAILS OF BARED WIRE FENCE

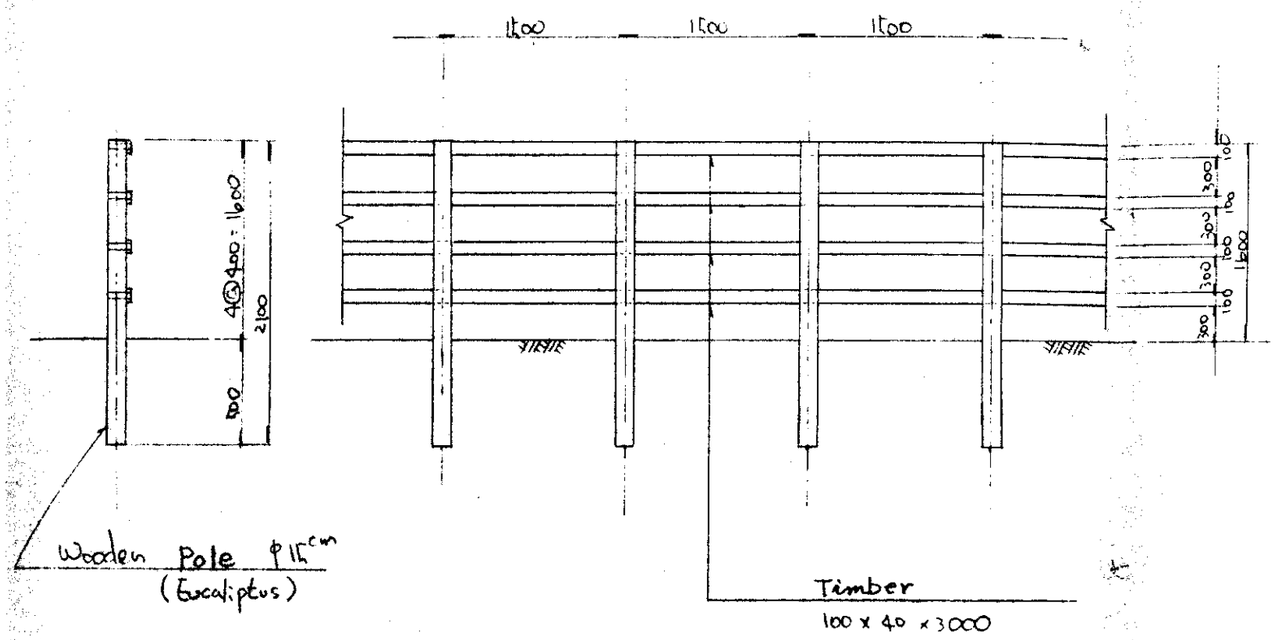
SCALE:

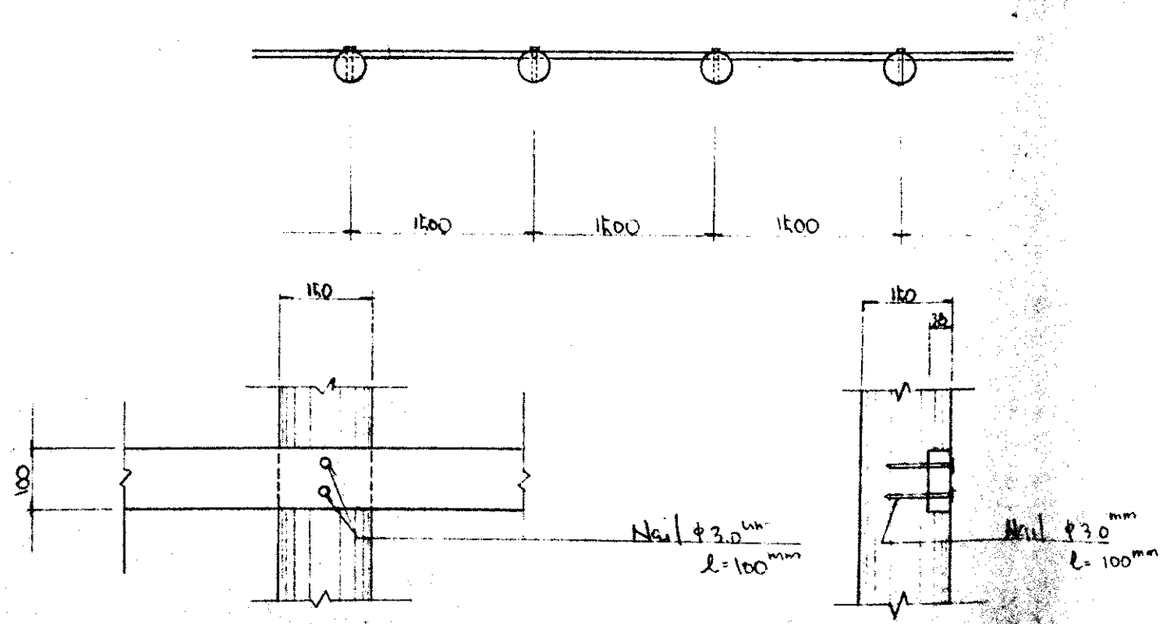
DATE: | DWG NO 7

JAPAN INTERNATIONAL COOPERATION AGENCY

Wooden Fence

Scale 1:50





UNIVERSITY OF ZAMBIA
VETERINARY EDUCATION PROJECT

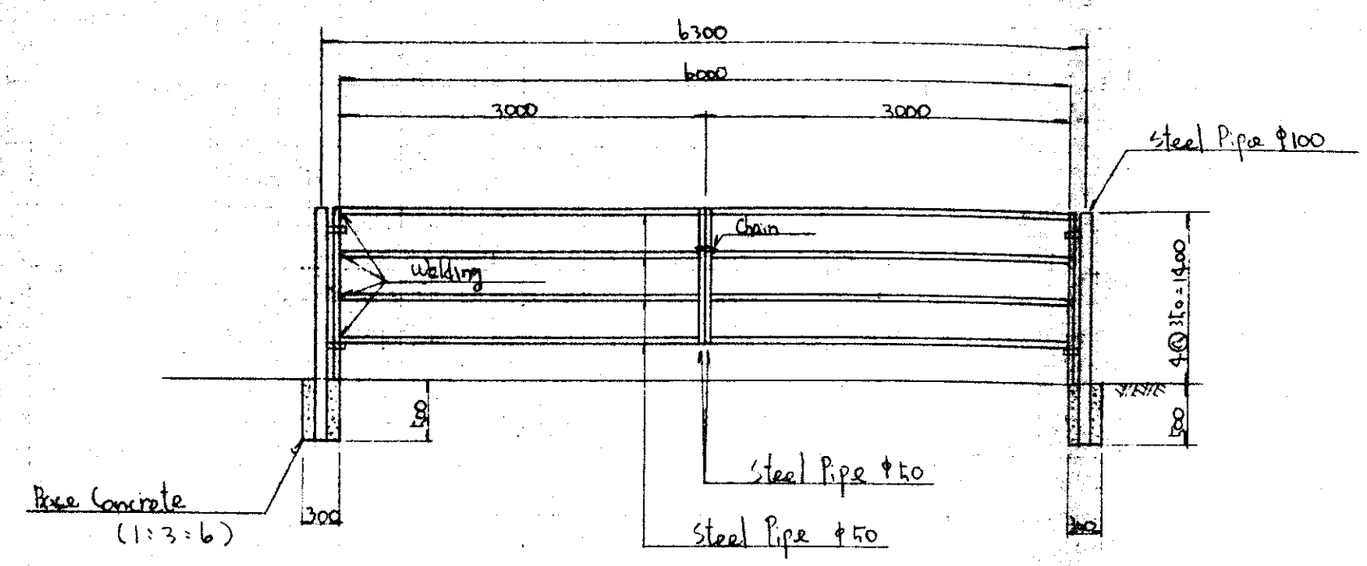
DETAILS OF WOODEN FENCE

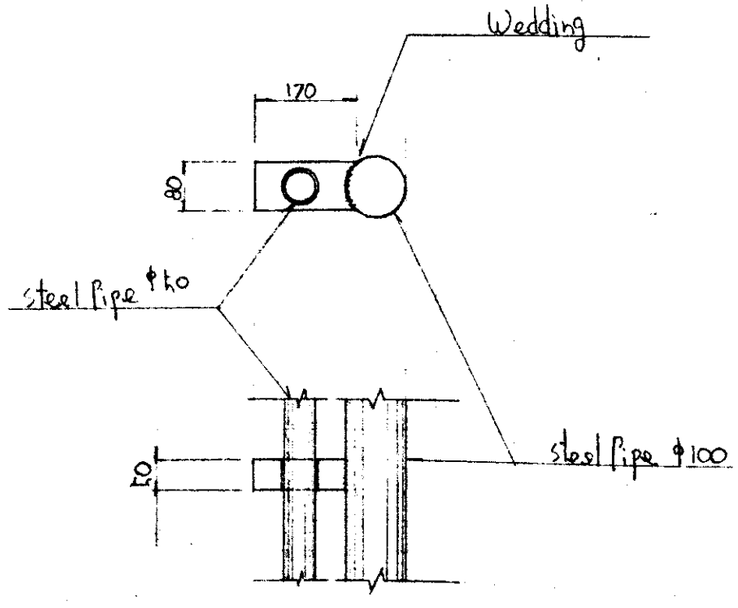
DWG. NO. 8

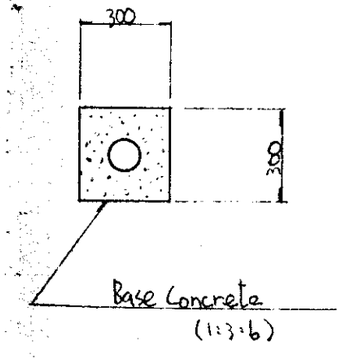
JAPAN INTERNATIONAL COOPERATION AGENCY

Gate (Type I)

scale 1:50







UNIVERSITY OF ZAMBIA
VETERINARY EDUCATION PROJECT

DETAILS OF GATE NO 1

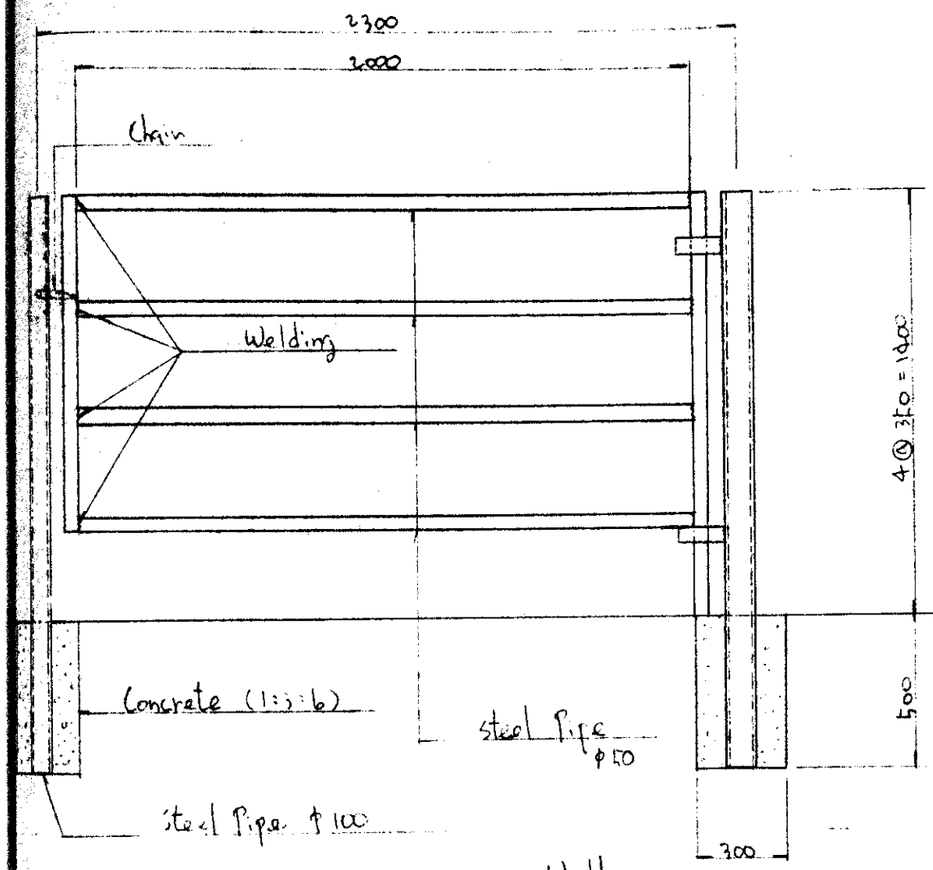
SCALE:

DATE: | DRG. No. 9

JAPAN INTERNATIONAL COOPERATION AGENCY

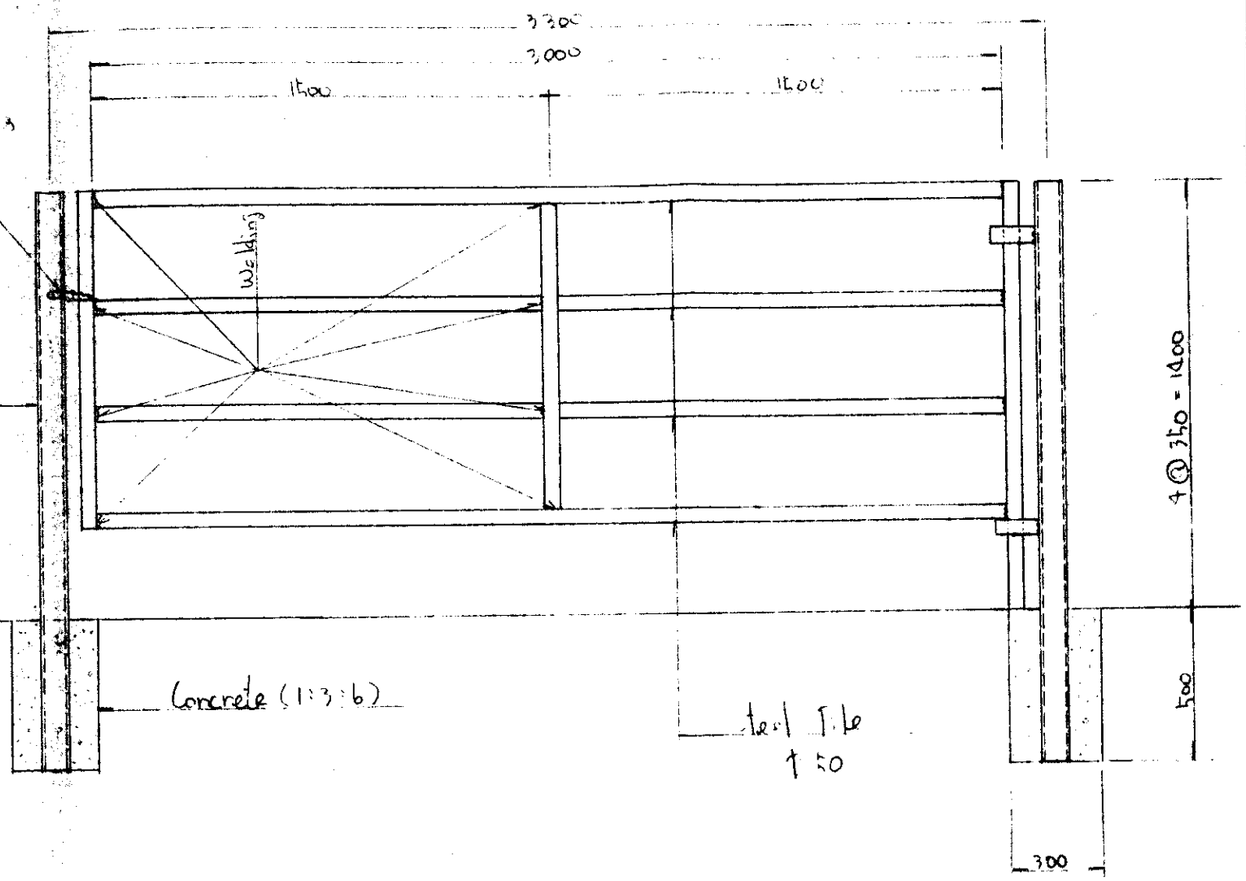
Gate (Type III)

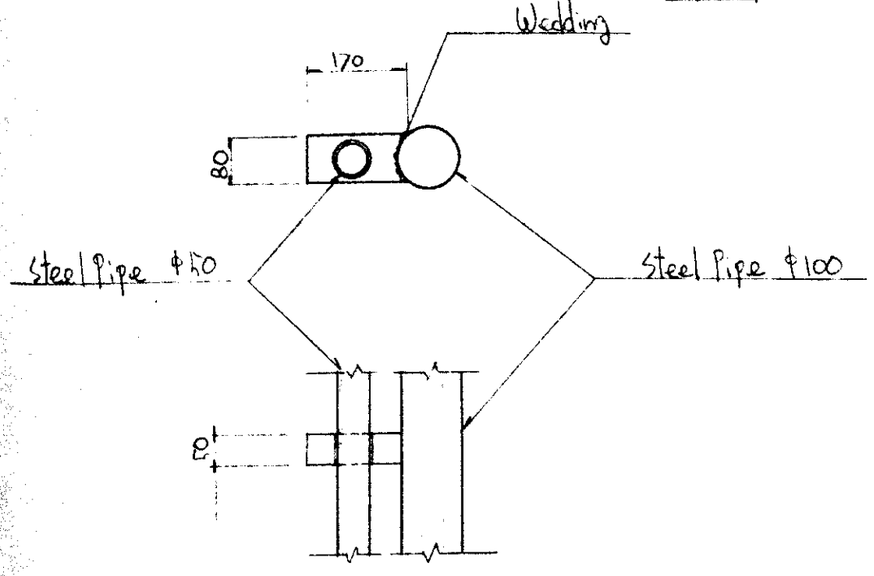
scale 1:20

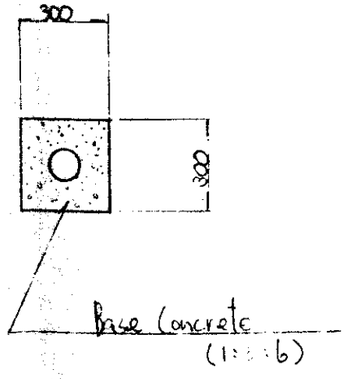


Gate (Type I)

scale 1:20







UNIVERSITY OF ZAMBIA
VETERINARY EDUCATION PROJECT

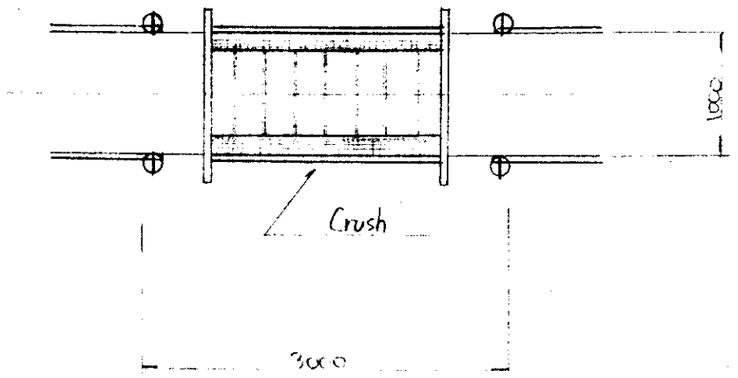
DETAILS OF GATE NO 2

NO. 10

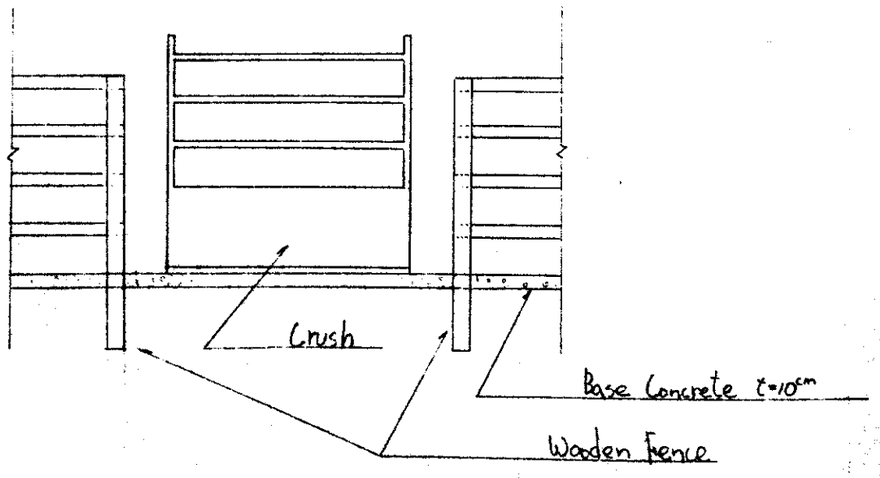
JAPAN INTERNATIONAL [illegible] AGENCY

Crush for Weighing, Branding, Dosing and Marking

Plan



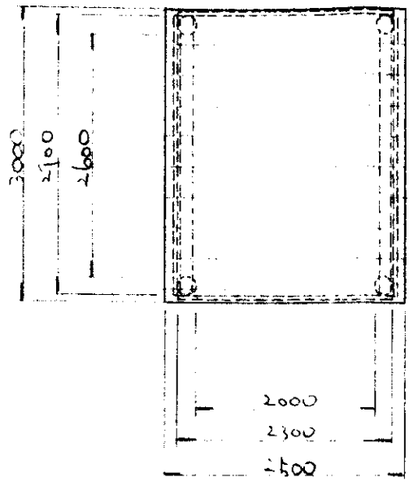
Section



※ Type : All steel with weighing scale

Shade Shelter

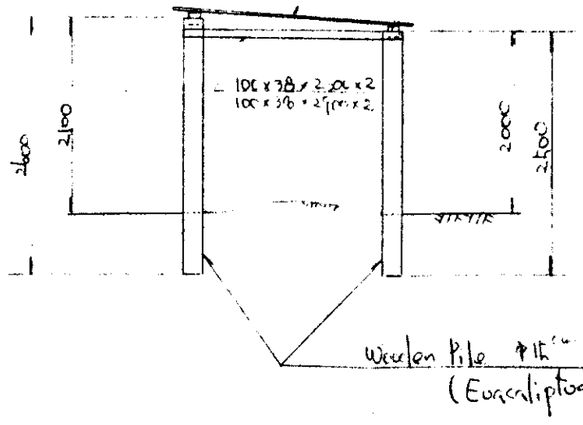
Plan



Section

Asbestos Cement Roofing 2500×3000

100×150×2700×2

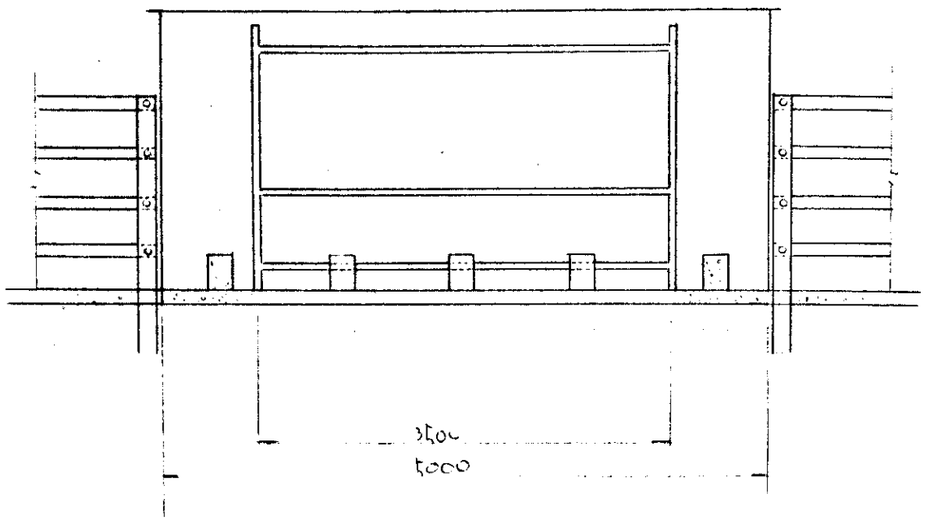


UNIVERSITY OF ZAMBIA VETERINARY EDUCATION PROJECT	
DETAILS OF CRUSH & SHADE SHELTER	
	DRAWING NO. 11
JAPAN INTERNATIONAL COOPERATION AGENCY	

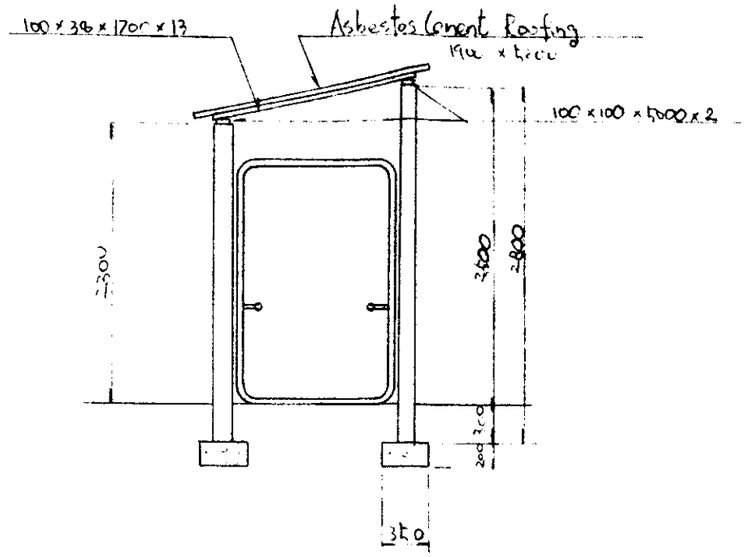
Spray Race

scale 1:40

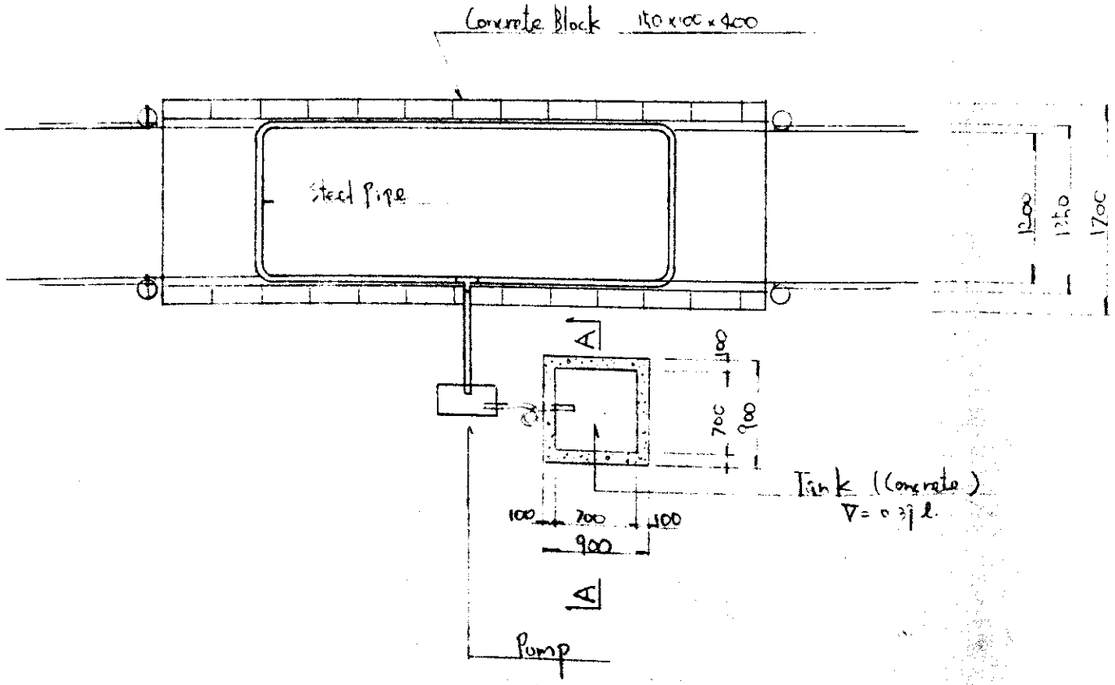
Front Elevation/Section



End Elevation / Section

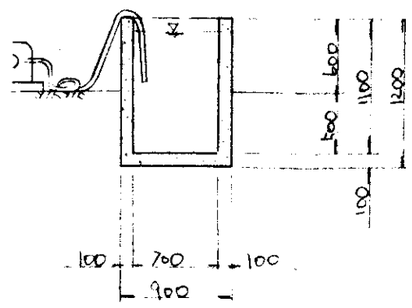


Plan



A – A Section

Tank



UNIVERSITY OF ZAMBIA
VETERINARY EDUCATION PROJECT

DETAILS OF SPRAY RACE

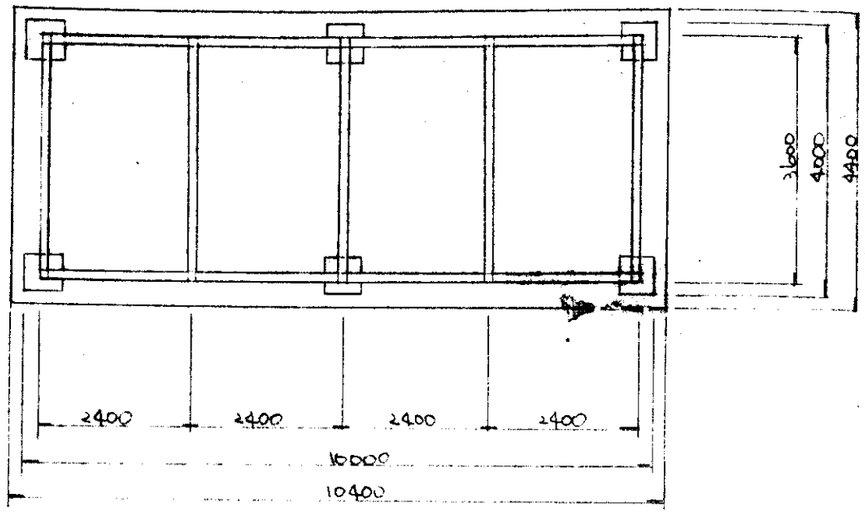
DRAWN
DATE
DRAWING NO. 12

Hay Stock

scale 1:100

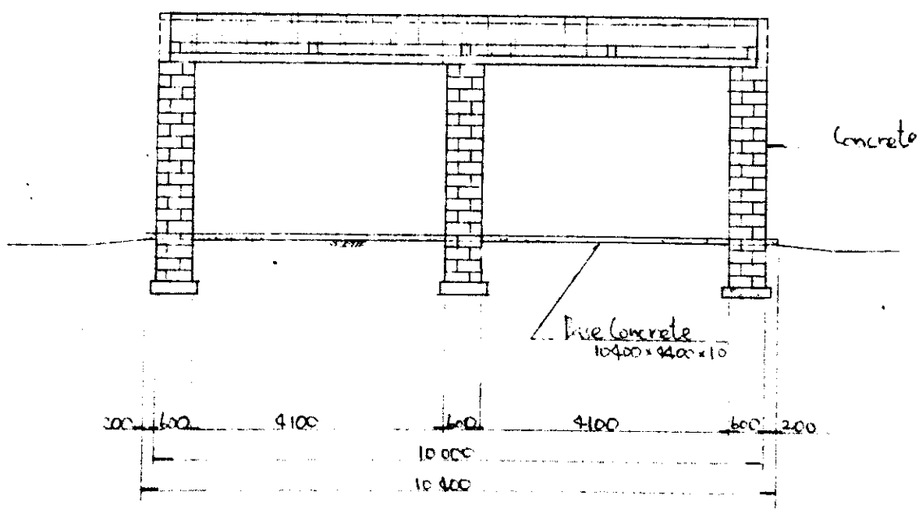
Plan

scale 1:100



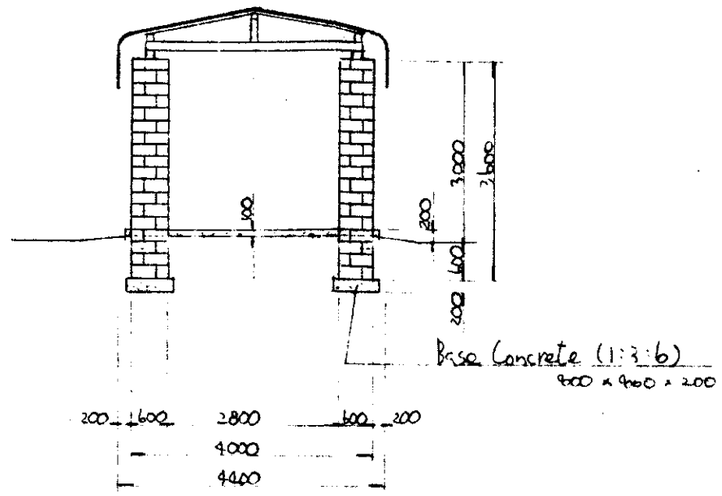
Section

scale 1:100



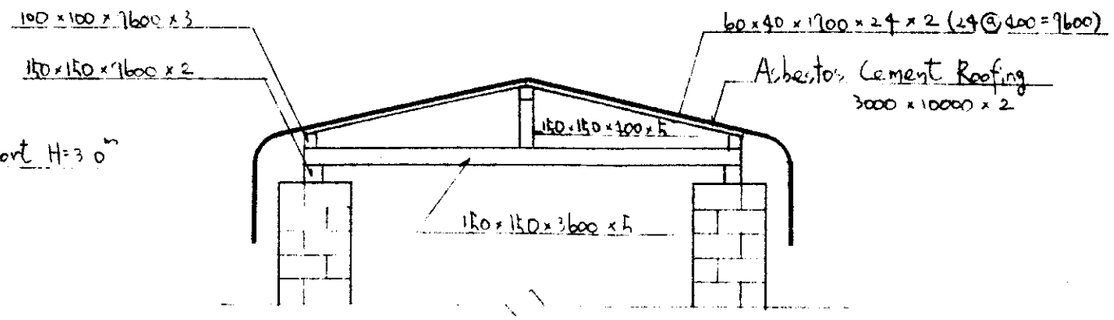
Section

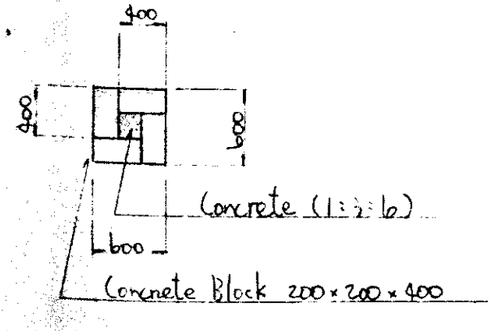
scale 1:100



Roof

scale 1:50



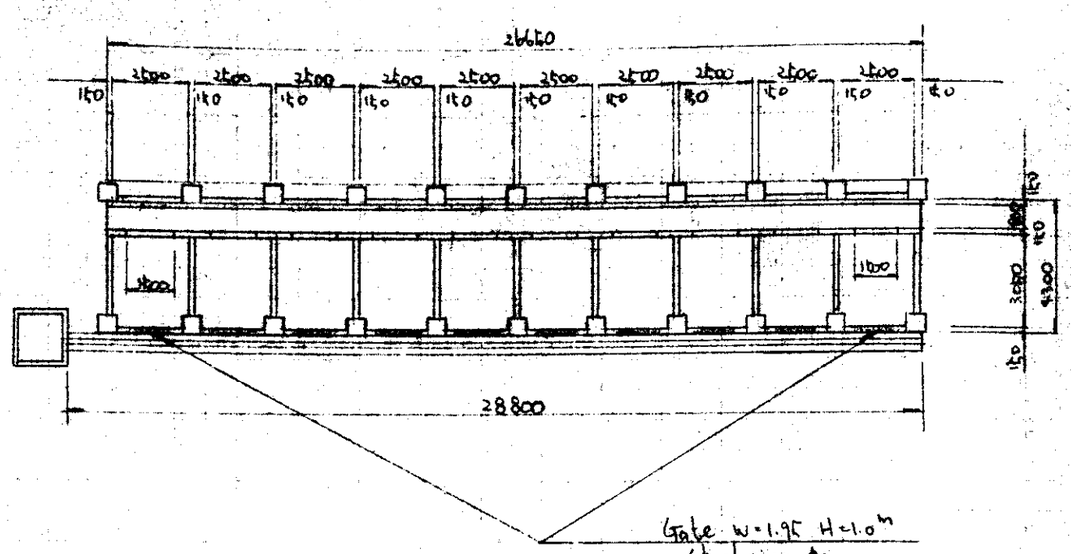


DETAILS OF HAY STOCK

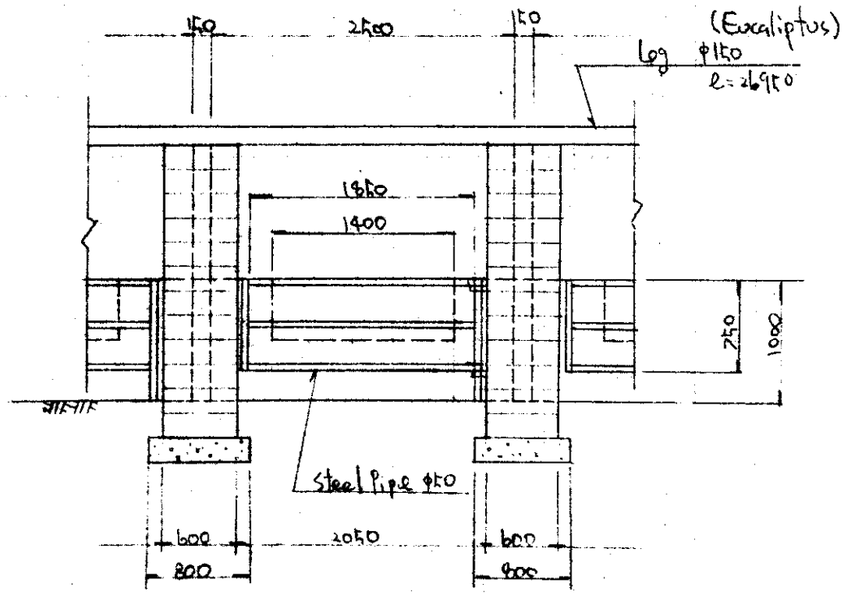
13

Holding Sheds

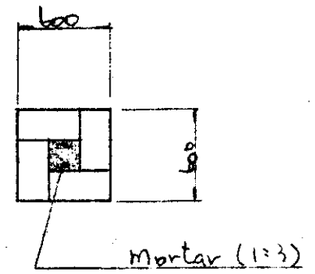
Plan
scale 1:200



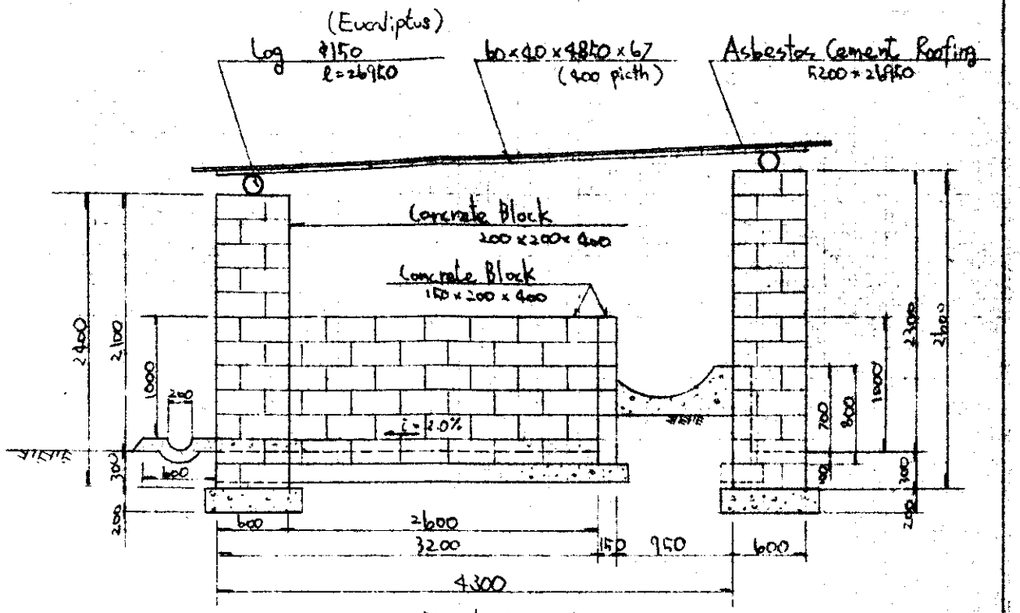
Section
scale 1:50



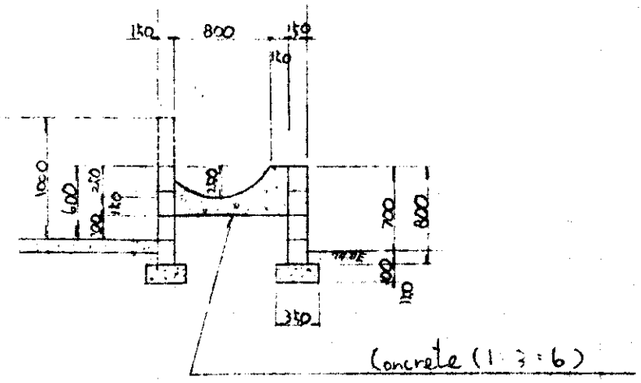
Timber
scale 1:10



Section
scale 1:50



Feed Trough
scale 1:50



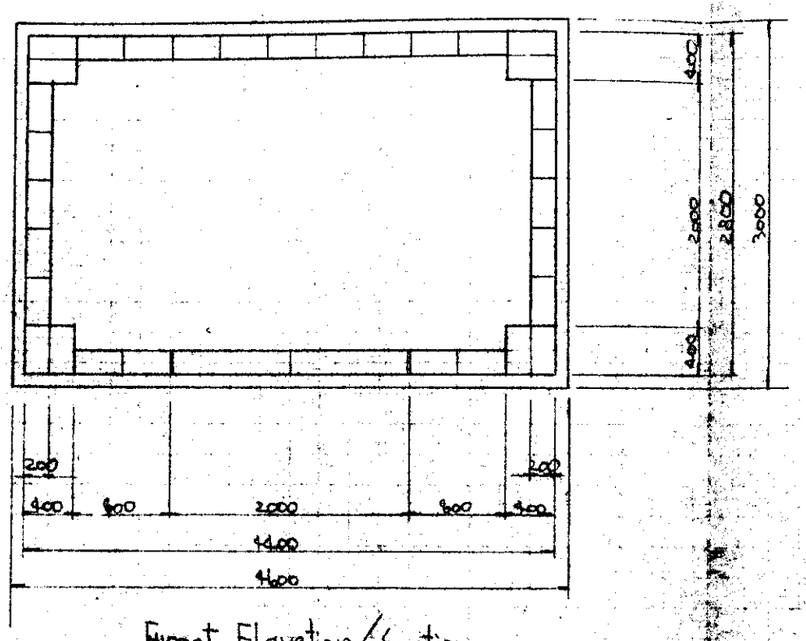
UNIVERSITY OF ZAMBIA
VETERINARY EDUCATION PROJECT

DETAILS OF HOLDING SHED

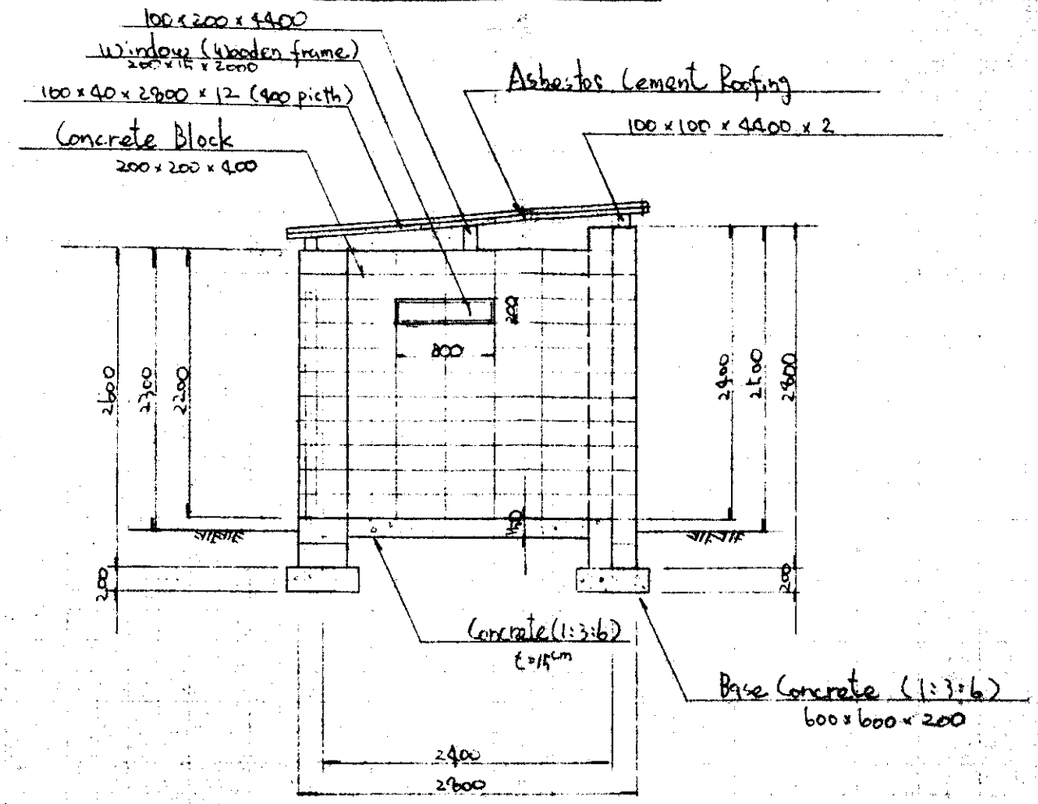
No. 14

Storage

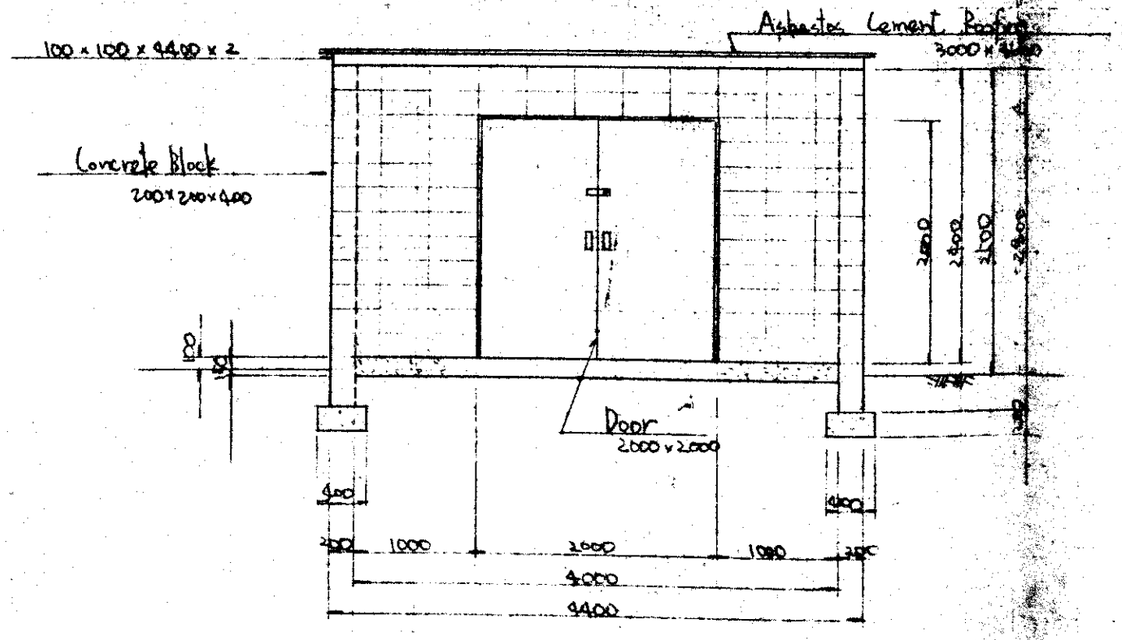
Plan



End Elevation/Section



Front Elevation/Section



UNIVERSITY OF ZAMBIA
VETERINARY EDUCATION PROJECT

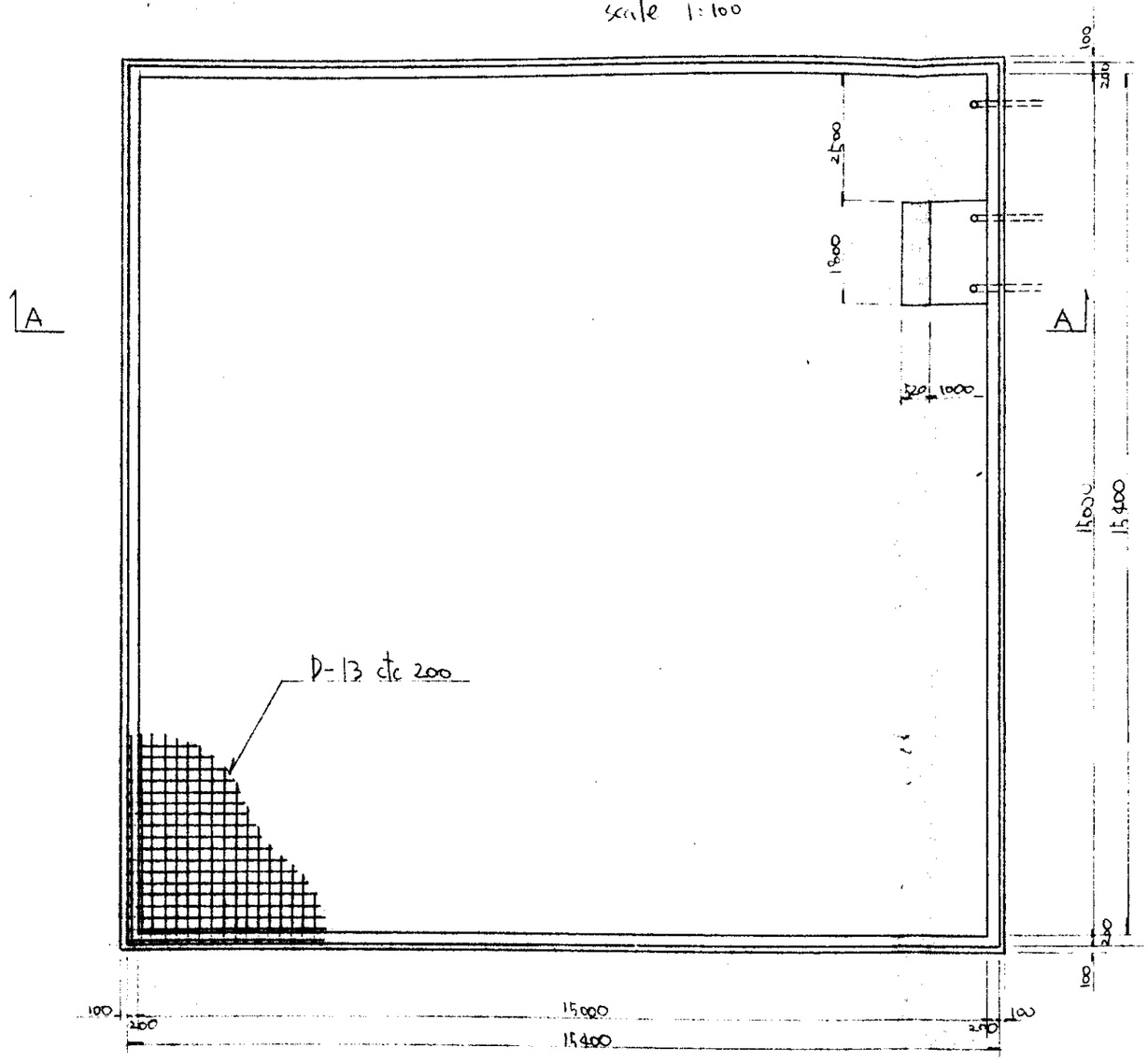
DETAILS OF STORAGE

SCALE

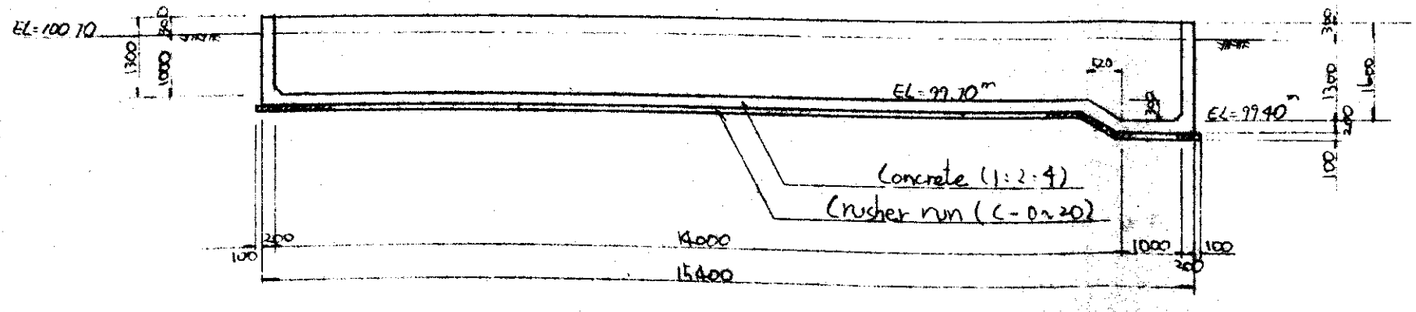
DATE | DWG NO. 15

JAPAN INTERNATIONAL COOPERATION AGENCY

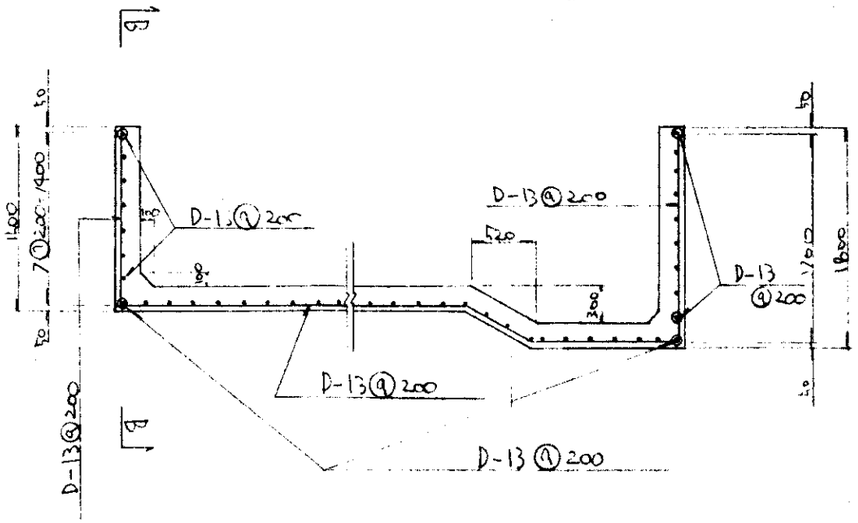
Plan
scale 1:100



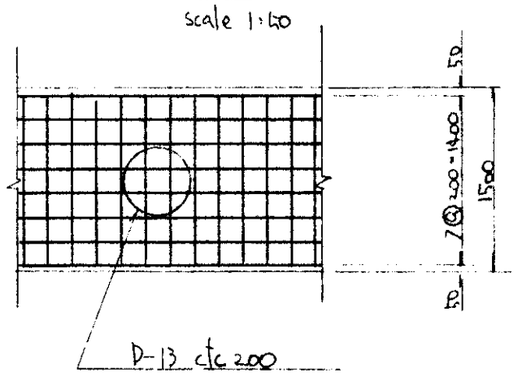
Section A-A
scale 1:100



Section A-A
(Reinforcing Bar)
scale 1:40



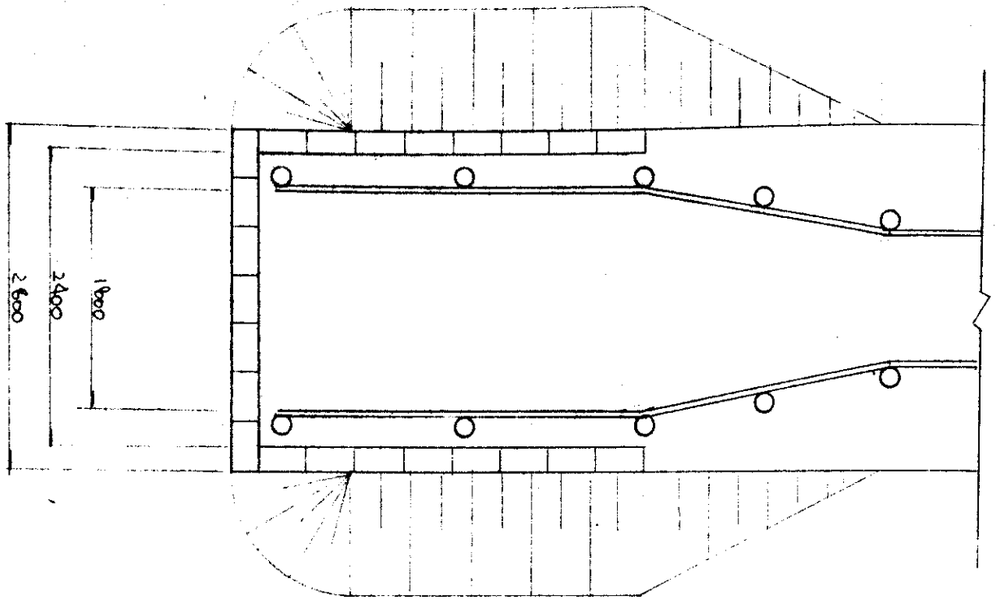
B - B Section
scale 1:40



UNIVERSITY OF ZAMBIA VETERINARY EDUCATION PROJECT	
DETAILS OF RESERVOIR	
SCALE:	
DATE:	DWG. NO. 16
JAPAN INTERNATIONAL COOPERATION AGENCY	

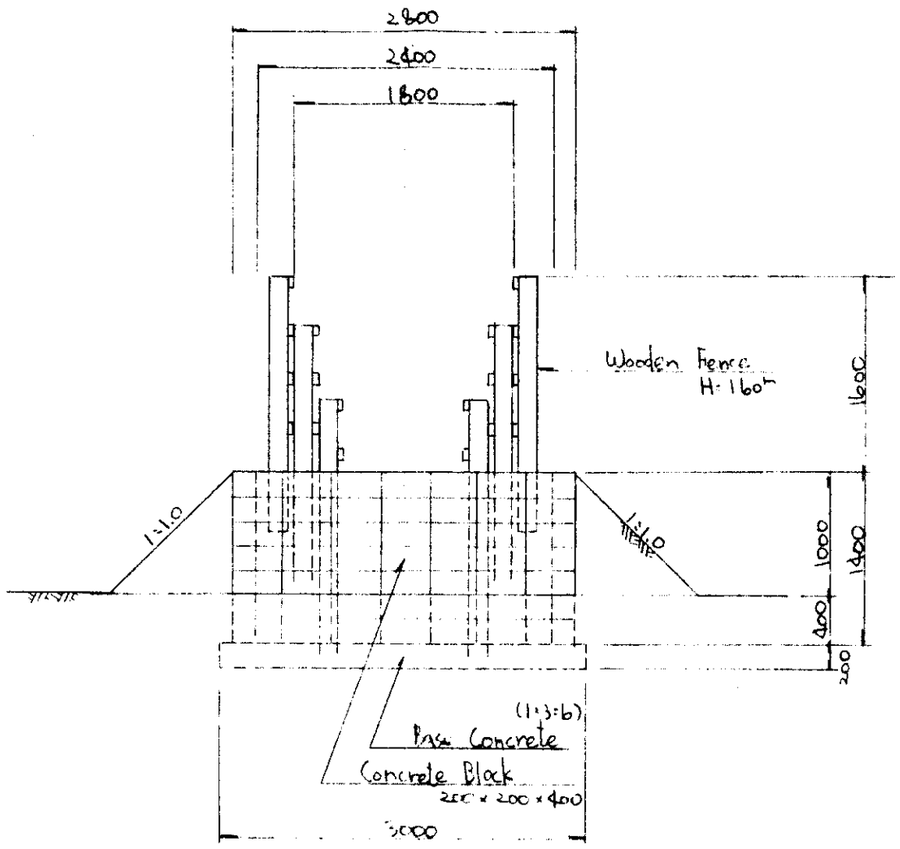
Plan

Scale 1:50



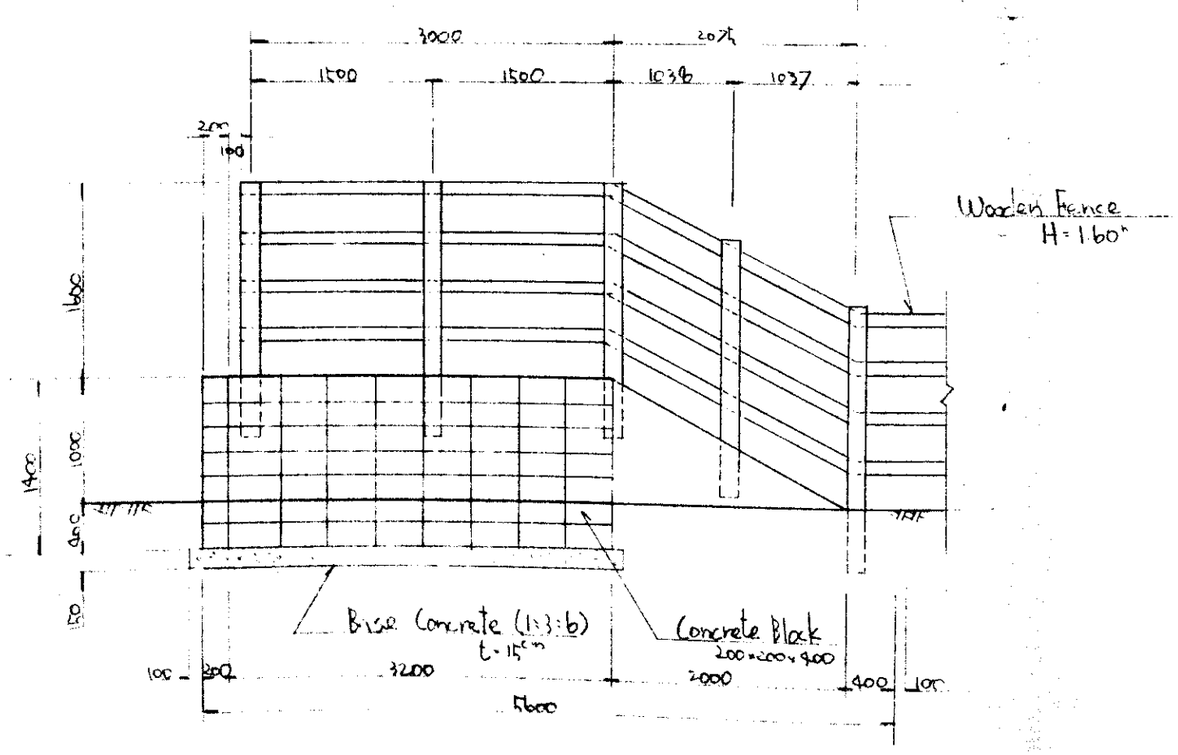
Section

Scale 1:50



Section

Scale 1:50



UNIVERSITY OF ZAMBIA
VETERINARY EDUCATION PROJECT

DETAILS OF LOADING RAMP

SCALE:

DATE:

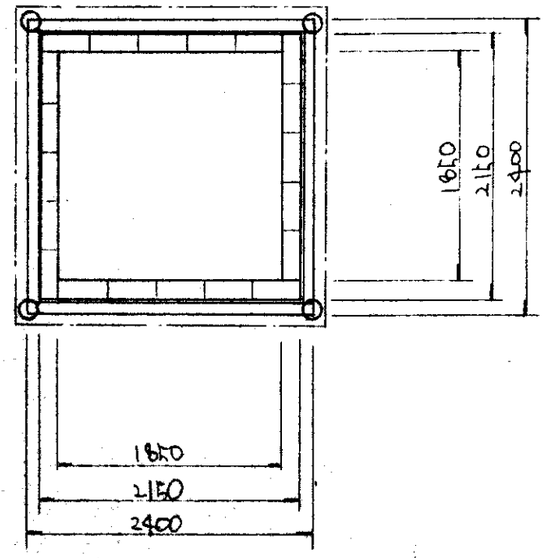
DWG. NO. 17

JAPAN INTERNATIONAL COOPERATION AGENCY

Manure stock

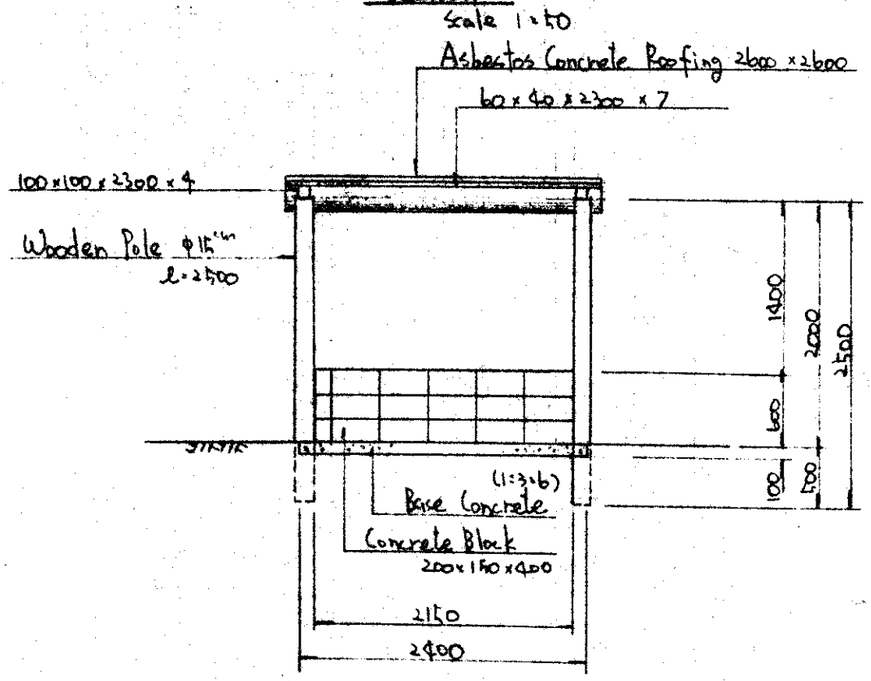
Plan

Scale 1:50



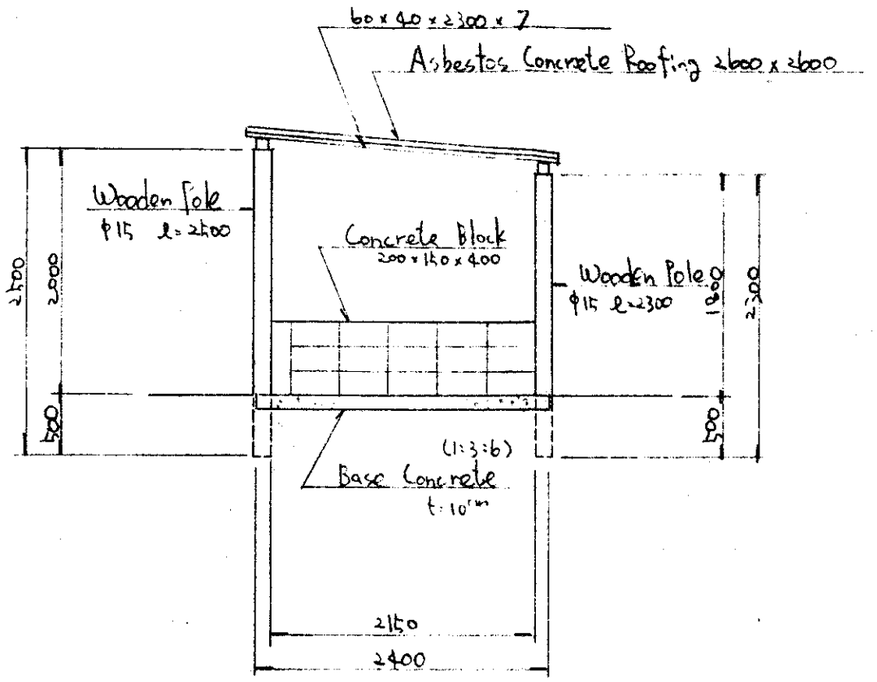
Section

Scale 1:50



Section

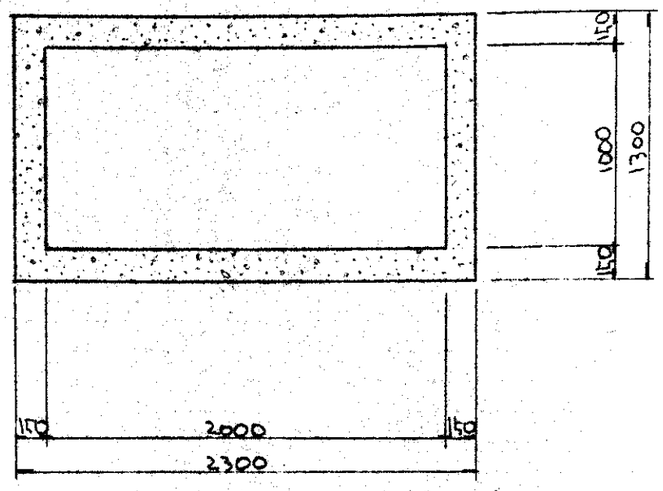
Scale 1:50



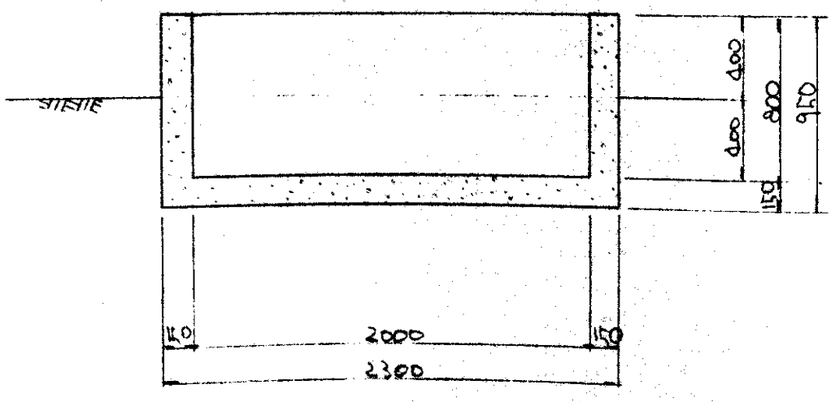
UNIVERSITY OF ZAMBIA VETERINARY EDUCATION PROJECT	
DETAILS OF MANURE STOCK	
SCALE:	
DATE:	DRAWING NO. 18
JAPAN INTERNATIONAL COOPERATION AGENCY	

Water Trough

Plan
Scale 1:30

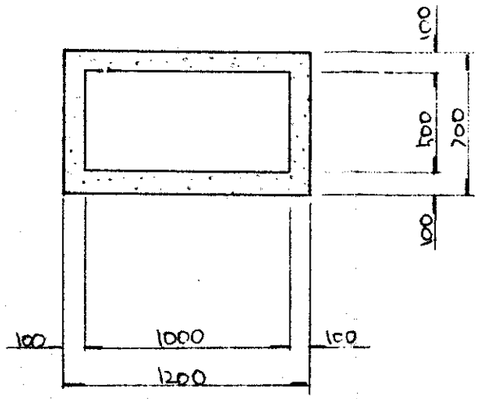


Section
Scale 1:30

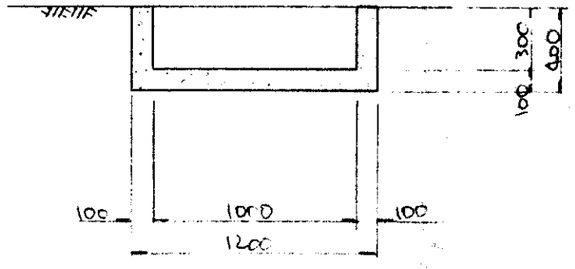


Sterilizing Basin

Plan
Scale 1:30



Section
Scale 1:30



UNIVERSITY OF ZAMBIA
VETERINARY EDUCATION PROJECT

DETAILS OF WATER TROUGH & STERILIZING BASIN

SCALE:

DATE: DRG NO. 19

JAPAN INTERNATIONAL COOPERATION AGENCY

PLAN s=1/30

SECTION A-A s=1/30

SECTION B-B s=1/30

SECTION C-C s=1/30

SECTION D-D s=1/30

RESERVOIR

PANEL

ASBESTOS CEMENT ROOFING 4000×3600

60×90×3500×11

BEAM 150φ (EUCALIPTUS)

50φ SLUICE VALVE

50φ CHECK VALVE

40φ×50φ REDUCER

50φ×100φ REDUCER

CONCRETE BLOCK (400×150×400)

BASE CONCRETE (1:3:6)

80φ SLUICE VALVE

80φ CHECK VALVE

80φ SUCTION PIPE

80φ BOOSTER PUMP, 2 SETS (HORIZONTAL SUCTION VOLUTE TYPE)

80φ FOOT VALVE

VP φ 125

VALVE BOX □300

T-BAR

SLUICE VALVE φ100

TS TEE φ125×100

CONCRETE BLOCK (200×150×400)

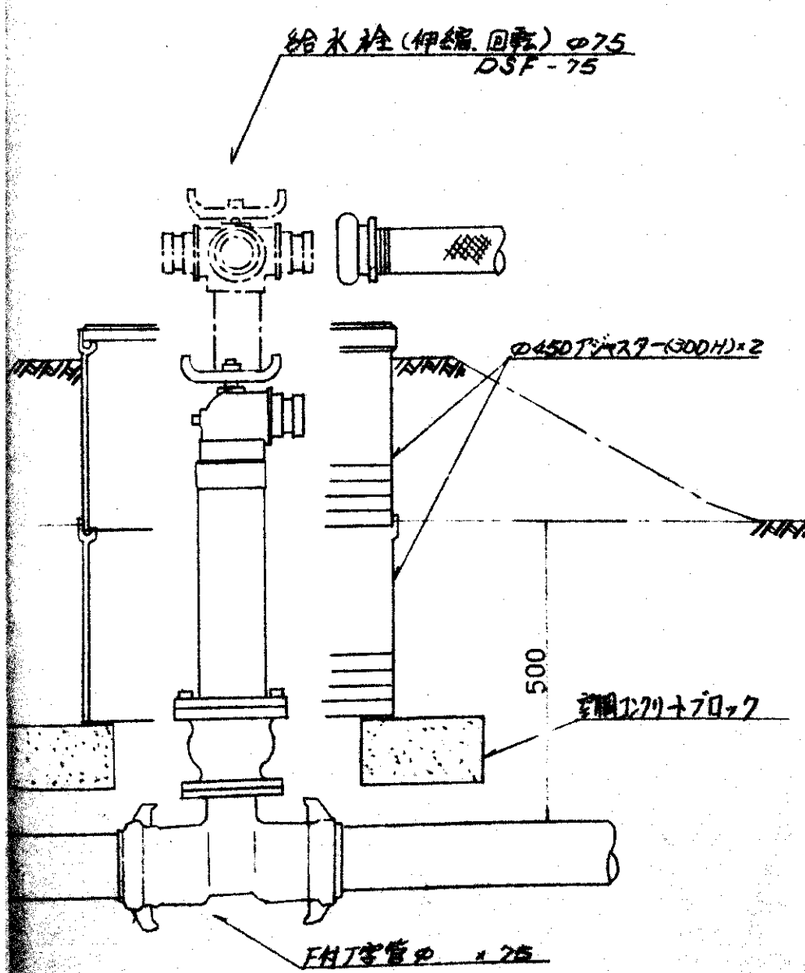
BASE CONCRETE (1:3:6)

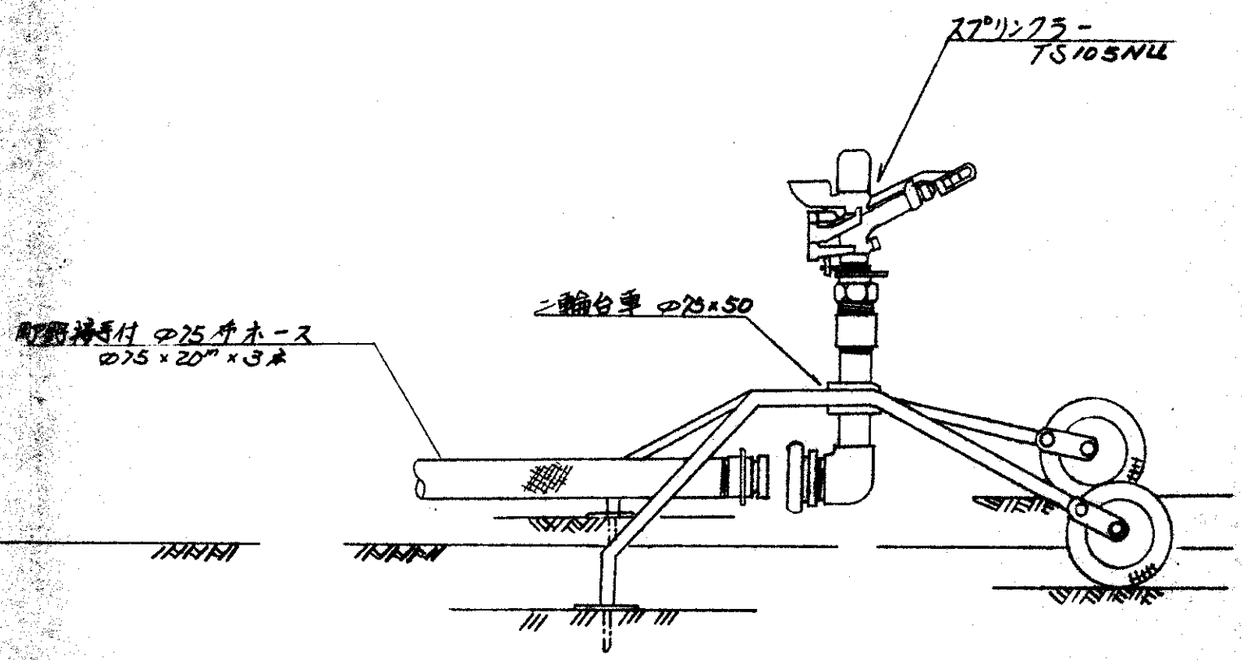
INSTALLATION OF PUMP & PUMP HOUSE

DATE

JICA

給水栓エφ75、末端可搬スプリンクラーセット標準図





UNIVERSITY OF ZAMBIA VETERINARY EDUCATION PROJECT	
DETAILS OF SPRINKLER	
	DWG NO. 21
JAPAN INTERNATIONAL COOPERATION AGENCY	

SGR REDUCER ϕ125 × ϕ100
SGR TEE (with FLANGE) ϕ100 × ϕ75
DOCKLER JOINT (NA-C)
ϕ125 - 1
ϕ100 - 3
HYDRANT EQUIPMENT -1

SGR TEE ϕ125 × ϕ125
DOCKLER JOINT (NA-C)
ϕ125 - 3

SGR TEE ϕ125 × ϕ100
DOCKLER JOINT (NA-C)
ϕ125 - 2
ϕ100 - 1

SGR FLANGED SOCKET ϕ125
DOCKLER JOINT (NA-C) ϕ125
STEEL REDUCER ϕ 4" × ϕ 5"

SGR BEND ϕ125 × 90°
SGR REDUCER ϕ125 × ϕ100
SGR TEE (with FLANGE)
ϕ100 × ϕ75
DOCKLER JOINT (NA-C)
ϕ125 - 3
ϕ100 - 3
HYDRANT EQUIPMENT-1

SGR TEE ϕ125 × ϕ100
DOCKLER JOINT (NA-C)
ϕ125 - 2
ϕ100 - 1

SGR BEND ϕ125 × 90°
DOCKLER JOINT (NA-C)
ϕ125 - 2

SGR TEE ϕ125 × ϕ125
DOCKLER JOINT (NA-C)
ϕ125 - 7
SGR FLANGED SOCKET
ϕ125 - 4
SLUICE VALVE
ϕ125 - 2

SGR REDUCER ϕ125 × ϕ100
SGR TEE (with FLANGE) ϕ100 × ϕ75
DOCKLER JOINT (NA-C) ϕ125 - 1
ϕ100 - 3
HYDRANT EQUIPMENT - 1

WATER TROUGH
See drawing 24-2

HYDRANT
See drawing 23-2

HYDRANT
See drawing 23-1

WATER TROUGH
See drawing 24-1

HYDRANT
See drawing 23-1

HYDRANT
See drawing 23-2

WATER TROUGH
See drawing 24-2

WATER TROUGH
See drawing 24-2

HYDRANT
See drawing 23-2

HYDRANT
See drawing 23-2

WATER TROUGH
See drawing 24-2

HYDRANT
See drawing 23-2

WATER TROUGH
See drawing 24-2

P
K-1
K-2
K-3
K-4
K-5
K-6
K-7
K-8
K-9
K-10
A
B
C
D
E
F

VP ϕ100
VP ϕ125

L = 28 m
L = 71.0 m
L = 39.0 m
L = 112.0 m
L = 70.0 m
L = 62.0 m
L = 81.0 m
L = 121.0 m
L = 79.0 m
L = 62.0 m
L = 89.0 m
L = 71.0 m
L = 39.0 m
20.0 m
8.0 m
4.0 m
30.0 m

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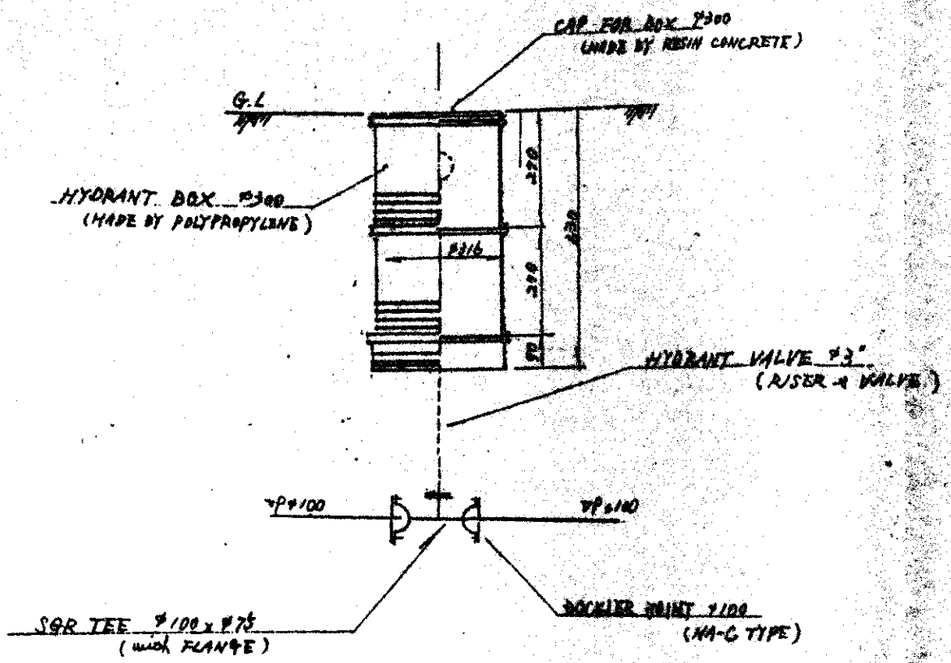
VETERINARY EDUCATION PROJECT

PIPING PLAN & FITTINGS NO 1

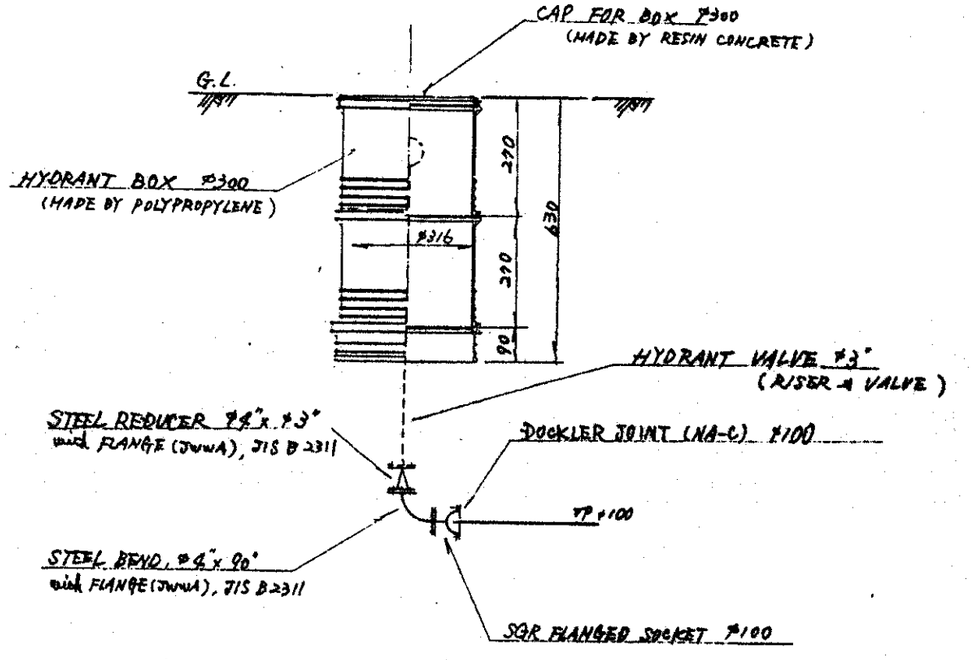
DRAWN
DATE
DRG. NO. 22

JAPAN INTERNATIONAL COOPERATION AGENCY

23-1



23-2



UNIVERSITY OF ZAMBIA
VETERINARY EDUCATION PROJECT

PIPING PLAN & FITTINGS NO 2

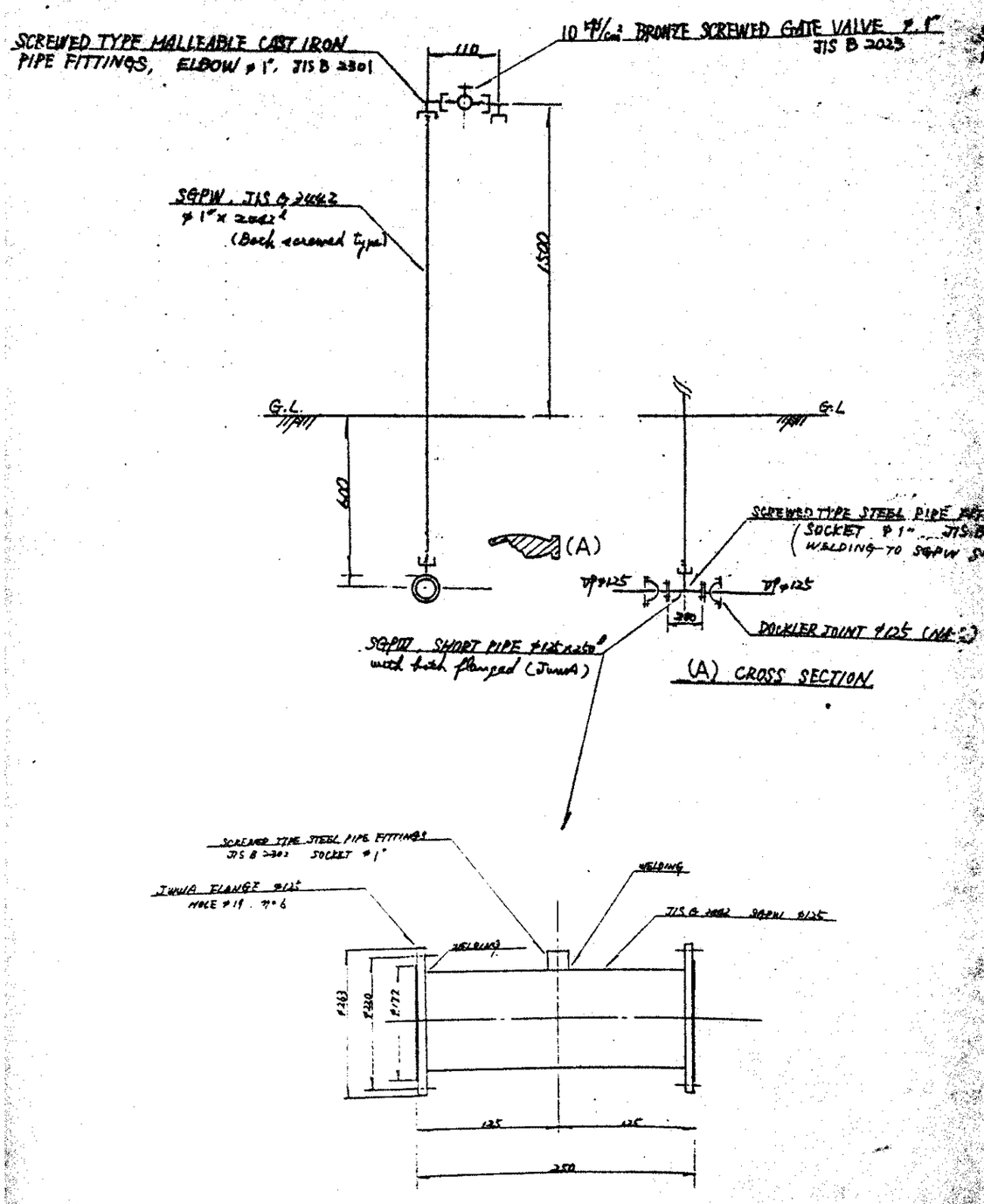
SCALE:

DATE:

DWG NO. 23

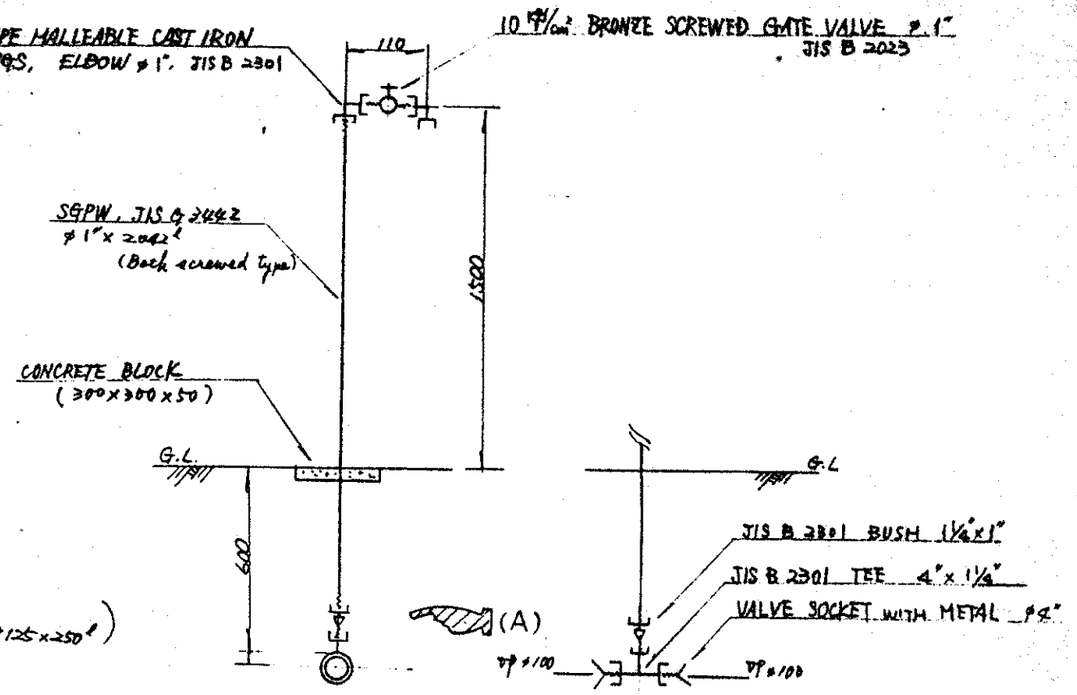
JAPAN INTERNATIONAL COOPERATION AGENCY

24-1



(A) CROSS SECTION

24-2



(A) CROSS SECTION

UNIVERSITY OF ZAMBIA
VETERINARY EDUCATION PROJECT

PIPING PLAN & FITTINGS NO 3

SCALE:

DATE:

DWG NO 24

JAPAN INTERNATIONAL COOPERATION AGENCY