reduction of the degree of dependence on the municipal supply ($35m^3$/day on working days) and its replacement by rainwater is deemed desirable. In this manner, a stable water supply for the TCH will be established, enabling the smooth operation of the hospital. In the case of both well water and sea water, securing of the design supply volume will be easy in view of their abundance provided that the problems described earlier are addressed.

4-2-3 Use of Rainwater

In the 45 year period from 1947 to 1991, the highest annual rainfall recorded was 3,843mm in 1987 while the lowest rainfall was 395mm in 1950 with an average of 1,994mm.

The TCH has a total roof area of $9,580.32m^2$ covering 29 buildings, connecting corridors and elevated water tanks except the roof of the Mortuary. As often stated, rainwater is an important source of drinking water in island countries. The idea is to use rainwater collected from the above roof area in those places currently using municipal water after its filtering and sterilization. At present, the TCH uses some $35m^3$/day of municipal water on working days for drinking, cooking, medical treatment and the cleaning of hospital equipment. This figure still falls short of the required $50m^3$/day. The following discussion is based on the premise that the current supply shortage, i.e. $15m^3$, will be met by rainwater.

The collection of rainwater from the entire roof area is impossible. The effective collection rate is believed to be approximately 75% taking evaporation and other losses into consideration. The following equation gives the resulting annual rainwater supply.

Annual Rainwater Supply = Roof Area x Annual Rainfall x 75%

The annual rainwater supply requirement is calculated by the following equation on the basis of $15m^3$ for each working day and $13.5m^3$ (reduced by 10% from $15m^3$) for each holiday.

Annual Rainwater Supply Requirement $= 15m^3/\text{day} \times 257 \text{ days} + 13.5m^3 \times 108 \text{ days}$
$= 5,313m^3$

Given the mean annual rainfall of 1,994mm, the required roof area to provide sufficient rainwater is calculated as follows.

$$\text{Required Roof Area} = \frac{\text{Required Rainwater Supply}}{\text{Mean Annual Rainfall}} \times 75\%$$

$$= \frac{5{,}313\text{m}^3}{1{,}994\text{mm} \times 0.75} = 3{,}553\text{m}^2$$

The actual usable existing roof area must be determined based on a comprehensive assessment of the tank capacity to be adopted, underground structures (including telephone, electricity, water supply and sewer systems buried between existing buildings) and the difficulty of the anticipated construction work.

The planned rainwater collection system is outlined next.

Firstly, rainwater will be collected from the roofs of buildings and led to the existing municipal water storage tanks via the filtering and sterilization processes. Mixed with the municipal water, it will then be pumped to elevated water tanks and supplied to buildings by the gravity method. The actual rainwater amount to be used will be determined by the municipal water supply amount.

The extensive premises of the TCH mean that water supply to the existing final water tanks by the gravity method requires an excavation depth of more than 3m with appropriate grading. In order to avoid such major earth work, water tanks will be introduced with a system allowing pressurized water supply using water pumps. Manual pump operation is preferable from the maintenance point of view. Water level control at each water tank will be simplified by allocating a similar roof area for each tank. Each tank will be provided with a feature allowing the visual checking of the water level.

Given the above requirements and conditions, the usable existing roof area totals 5,407.04m^2 as shown in Fig. 4-1. In reality, however, an additional roof area of 400 - 500m^2 is available with the water tanks, increasing the total roof area for rainwater collection to approximately 5,800 - 5,900m^2. This figure is some 160% of the required roof area of 3,553m^2. The feasible daily rainwater supply volume using the entire area is approximately 25m^3 assuming the 160% level of the 15m^3 required for a single working day. As a result, there will be a surplus supply capacity of 10m^3 vis-a-vis the minimum daily rainwater requirement. This surplus can be used to replace the municipal water supply, reducing the required water volume from the latter from 35m^3 to 25m^3 per working day. In short, a stable supply of service water for the TCH will be secured to contribute to the smooth operation of the TCH.

The target daily rainwater supply volume is set at an average of $25m^3$ and the following discussion assumes this target supply volume. Rainfall data for Tarawa Island for the last 45 years show that rainfall exceeding the mean annual rainfall was recorded for 21 years. Together with one year during which the rainfall was almost identical to the mean rainfall level and an additional 5 years during which the rainfall little differed from the mean rainfall level, it appears justifiable to use the mean annual rainfall as the basis for planning.

<u>Annual Required Rainfall (Target)</u>

$25m^3/day \times 257$ (working days) + $22.5m^3/day \times 108$ days (holidays) = $8,855m^3$

$$\text{Required Roof Area} = \frac{\text{Required Rainwater Supply}}{\text{Mean Annual Rainfall} \times 75\%}$$

$$= \frac{8,855m^3}{1,994mm \times 0.75} = 5,921m^2$$

This required roof area of $5,921m^2$ can be provided as discussed earlier. The basic design conditions of the Project have now been determined for a rainwater supply of $25m^3$/working day based on the mean annual rainfall.

Table 4-5 shows the estimated effective rainfall storage based on actual rainfall data for 1959 (during which the rainfall was almost identical to the mean annual rainfall), 1987 (year with the highest rainfall), 1948 (during which the rainfall was between the highest rainfall and mean rainfall) and 1971 (year with the lowest rainfall), assuming daily rainwater use of $25m^3$/working day.

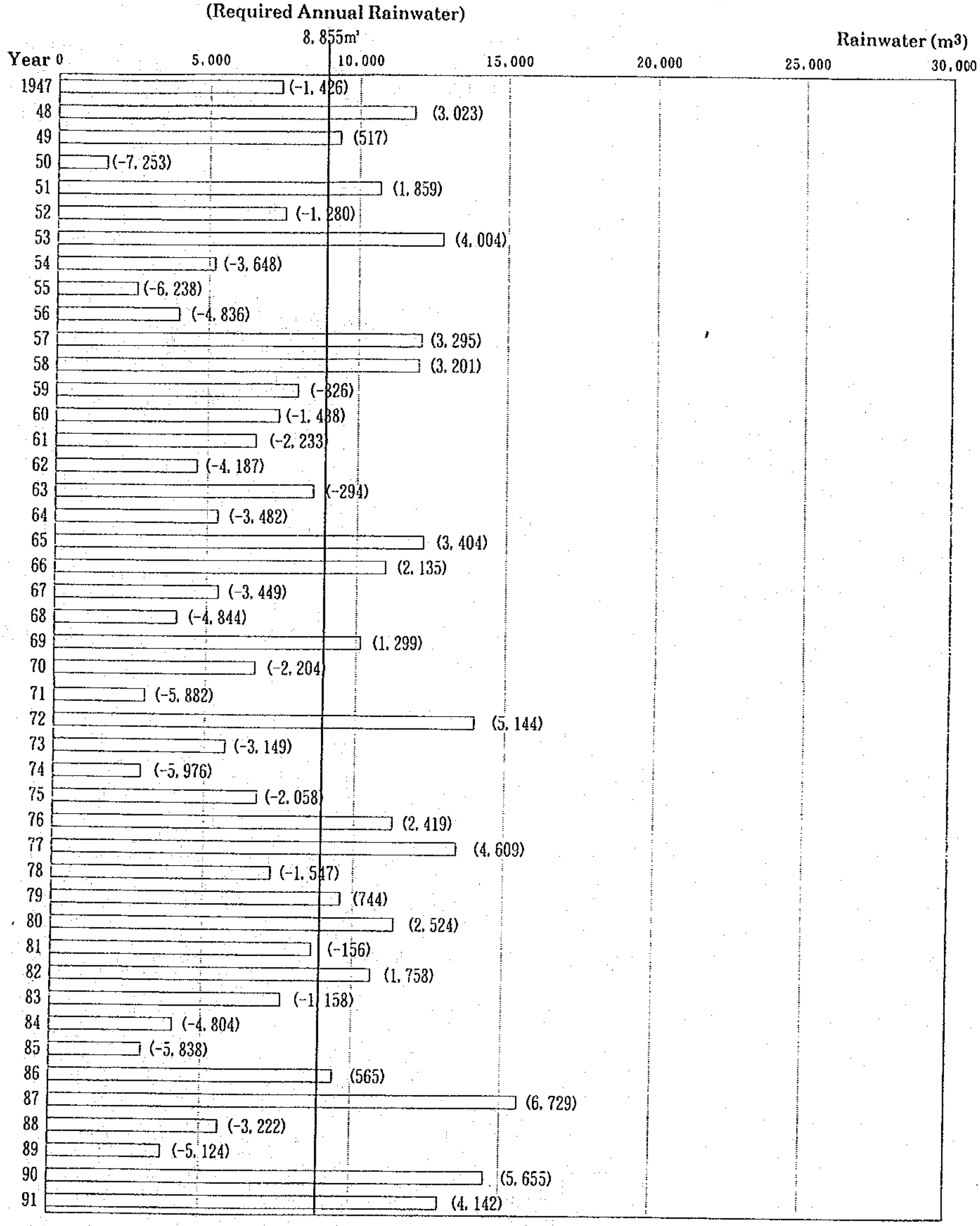
Table 4-5 Estimated Rainwater Storage (Daily Consumption of $25m^3$)

		JAN.	FEB.	MAR.	APR.	MAY	JUN.	JUL.	AUG.	SEP.	OCT.	NOV.	DEC.	Total
Rainfall 1959 (mm)		396	391	221	142	272	100	78	64	35	24	166	91	1,980
A: Effective Collection (m^3)		1,605	1,585	896	575	1,103	405	316	259	141	97	673	369	8,024
B: Water storage (m^3)	Surplus	867	847	158	−163	365	−333	−422	−479	−597	−641	−65	−369	−832
If 25 m^3/day is consumed	Accumulated surplus	867	1,714	1,872	1,709	2,074	1,741	1,319	840	243	−398	−463	−832	−832
Largest annual rainfall 1987 (mm)		449	492	241	493	285	353	411	330	160	250	130	259	3,843
A: Effective Collection (m^3)		1,820	1.995	977	1,999	1,155	1,431	1,666	1,338	608	1,013	527	1,050	15,579
B: Water storage (m^3)	Surplus	1,082	1,257	239	1,261	417	693	928	600	−130	275	−211	312	6,723
If 25 m^3/day is consumed	Accumulated surplus	1,082	2,339	2,578	3,839	4,256	4,949	5,877	6,477	6,347	6,622	6,411	6,723	6,723
Rainfall 1948 (mm)		539	237	458	406	212	226	153	119	28	33	135	383	2,929
A: Effective Collection (m^3)		2,185	961	1,857	1,646	859	916	620	482	113	133	547	1,553	11,872
B: Water storage (m^3)	Surplus	1,447	223	1,119	908	121	178	−118	−256	−625	−605	−191	815	3,016
If 25 m^3/day is consumed	Accumulated surplus	1,447	1,670	2,789	3,697	3,818	3,996	3,878	3,622	2,997	2,392	2,201	3,016	3,016
Least annual rainfall 1971 (mm)		25	44	4	78	60	98	97	41	41	100	69	76	733
A: Effective Collection (m^3)		101	178	16	316	243	397	393	166	166	405	279	308	2,968
B: Water storage (m^3)	Surplus	−637	−560	−722	−422	−495	−341	−345	−572	−572	−333	−459	−430	−5,888
If 25 m^3/day is consumed	Accumulated surplus	−637	−1,197	−1,919	−2,341	−2,836	−3,177	−3,522	−4,094	−4,666	−4,999	−5,458	−5,888	−5,888

According to the data given in Table 4-5, the maximum residual rainwater storage volume and the year end storage volume were 2,074m^3 and -832m^3 respectively in 1959, 6,723m^3 and 6,723m^3 in 1987, 3,996m^3 and 3,016m^3 in 1948 and -5,888m^3 and -5,888m^3 in 1971.

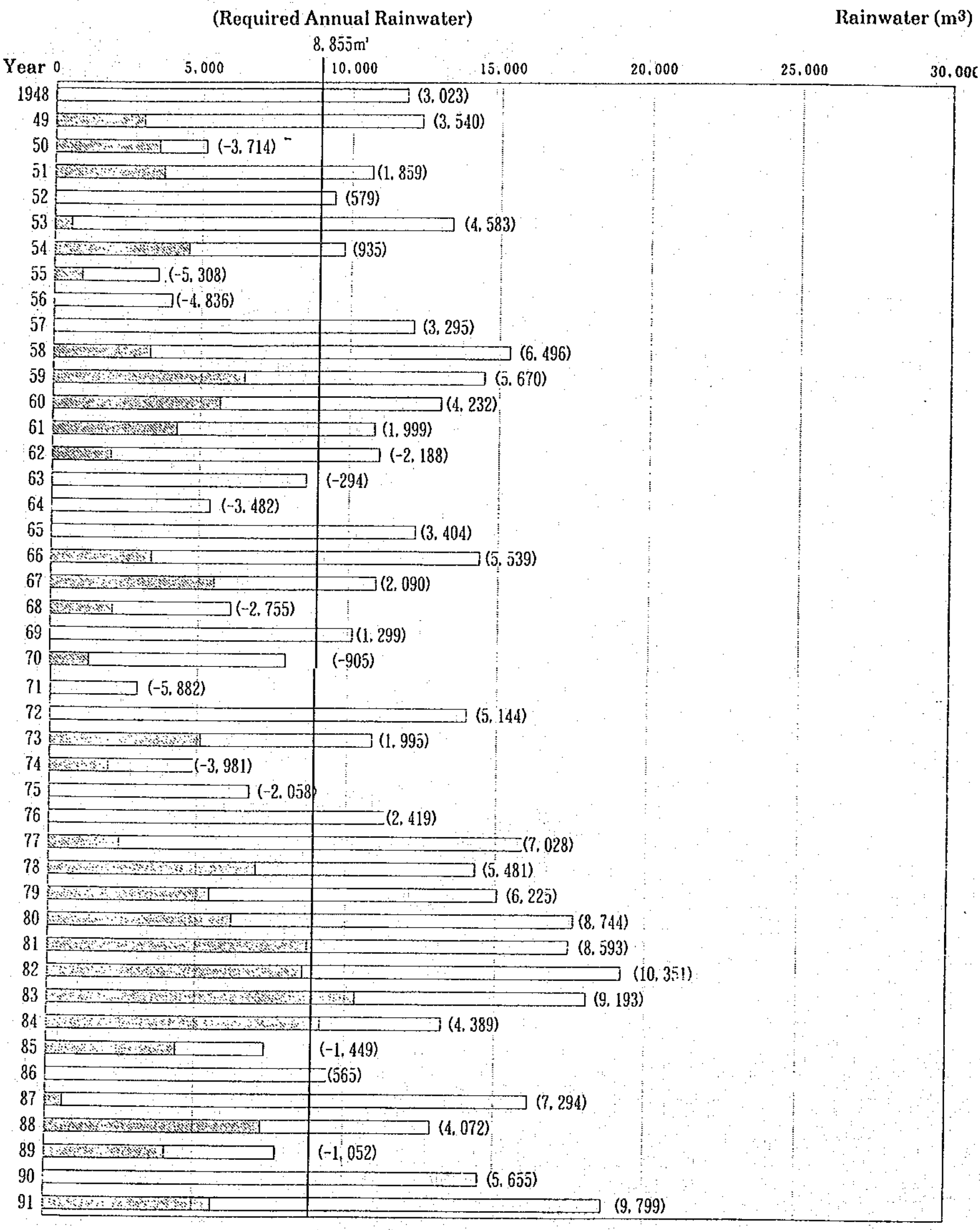
The municipal water supply is relatively ample in a year with a lot of rain and the amount of rainfall which can be collected from the roof area is naturally large in such a year. It would, therefore, be ideal if the usage ratio between municipal water and rainwater could be adjusted to enable the use of rainwater from the previous year during a year of low rainfall. A simple calculation suggests that the rainfall shortage of 5,888m^3 in 1971 could have been compensated for if the same amount of rainwater could be stored in a high rainfall year. In theory, a rainwater supply of 25m^3/working day could be secured in this way. The annual rainfall and required annual rainfall are shown in Table 4-6. The graph in Table 4-7 shows the year end rainwater storage on the condition that the residual rainwater from the previous year and the rainfall of the year in question are used to provide a rainwater supply of 25m^3/day. Tables 4-9/13 show the estimated daily residual rainfall.

Table 4-6 Rainfall and Required Annual Rainwater
(Daily consumption of 25 m³)



*( ) surplus rainwater

Table 4-7 Estimated Surplus Rainwater Based on Rainfall and Required Annual Rainwater (Daily consumption of 25 m³)



*( ) surplus rainwater

▩ is the previous year's surplus rainwater (Required Annual Rainwater)

Table 4-8 Estimated Water Storage (Daily Consumption: working days 25 m^3, holidays 22.5 m^3)(Daily accumulative)

	Day of Week	MON.	TUE.	WED.	THU.	FRI.	SAT.	SUN.	MON.	TUE.	WED.	THU.	FRI.	SAT.	SUN.	MON.	TUE.	TOTAL
	Date	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	
Rainfall January 1990 (mm)		3.5	193.1	39.1	0.0	3.3	3.2	32.5	5.7	0.1	0.3	11.1	0.3	0.4	32.6	26.7	0.5	
A: Effective Collection (m^3)		14.2	783.1	158.6		13.4	13.0	131.8	23.1	0.4	1.2	45.0	1.2	1.6	132.2	108.3	2.0	
B: Water storage (m^3)	Surplus	−10.8	758.1	133.6	−25.0	−11.6	−9.5	109.3	−1.9	−24.6	−23.8	20.0	−23.8	−20.9	109.7	83.3	−23.0	
If 25 m^3/day is consumed	Accumulated surplus	−10.8	747.3	880.9	855.9	844.3	834.8	944.1	942.2	917.6	893.8	913.8	890.0	869.1	978.8	1,062.1	1,039.1	
	Day of Week	WED.	THU.	FRI.	SAT.	SUN.	MON.	TUE.	WED.	THU.	FRI.	SAT.	SUN.	MON.	TUE.	WED.		
	Date	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31		
Rainfall January 1990 (mm)		0.0	11.4	25.9	0.2	52.6	10.4	60.9	13.4	114.9	1.2	0.0	0.0	0.0	0.0	0.0		643.3
A: Effective Collection (m^3)			46.2	105.0	0.8	213.3	42.2	247.0	54.3	466.0	4.9							2,608.8
B: Water storage (m^3)	Surplus	−25.0	21.2	80.0	−24.2	190.8	19.7	222.0	29.3	441.0	−20.1	−25.0	−22.5	−22.5	−25.0	−25.0		1,853.8
If 25 m^3/day is consumed	Accumulated surplus	1,014.1	1,035.3	1,115.3	1,091.1	1,281.9	1,301.6	1,523.6	1,552.9	1,993.9	1,973.8	1,948.8	1,926.3	1,903.8	1,878.8	1,853.8		1,853.8

A: Roof area 5,407.04 $mm^2 \times$ rainfall (mm) $\times 0.75 \times 0.001$

B: Working days = Effective water collected(A) − 25m^3

Holidays = Effective water collected(A) − 22.5m^3

Table 4-9 Estimated Water Storage (Water use: working days 25 m^3, holidays 22.5 m^3)(Daily accumulative)

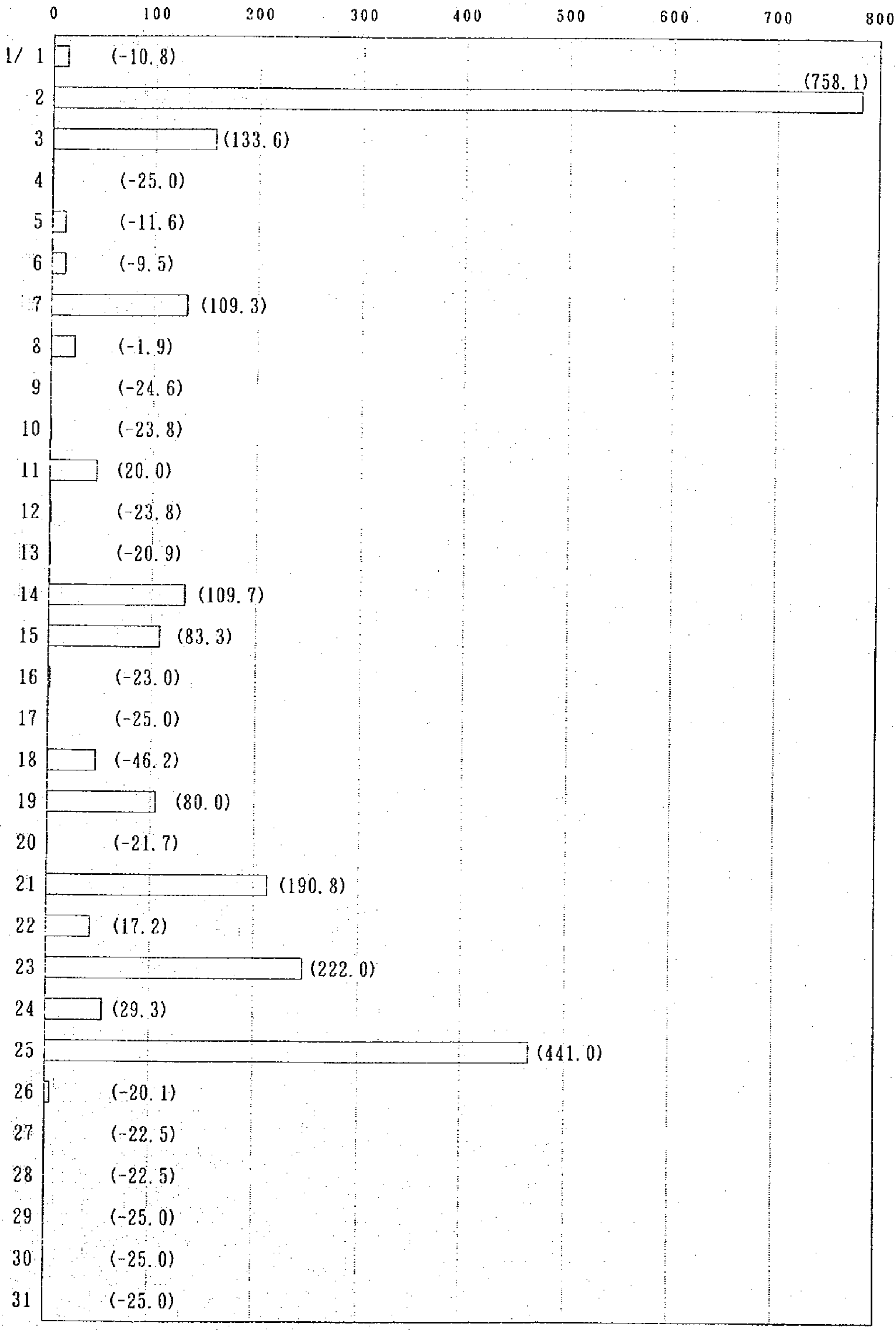
	Day of Week	SUN.	MON.	TUE.	WED.	THU.	FRI.	SAT.	SUN.	MON.	TUE.	WED.	THU.	FRI.	SAT.	SUN.	MON.	TOTAL
	Date	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	
Rainfall April 1990 (mm)		114.7	38.9	1.6	2.4	34.5	7.3	23.2	21.3	0.0	3.3	25.5	11.1	0.0	0.0	1.4	3.2	
A: Effective Collection (m^3)		465.1	157.8	6.5	9.7	139.9	29.6	94.1	86.4	0.0	13.4	103.4	45.0	0.0	0.0	5.7	13.0	
B: Water storage (m^3)	Surplus	442.6	132.8	−18.5	−15.3	114.9	4.6	71.6	63.9	−25.0	−11.6	78.4	20.0	−25.0	−22.5	−16.8	−12.0	
If 25 m^3/day is consumed	Accumulated surplus	442.6	575.4	556.9	541.6	656.6	661.1	732.7	796.6	771.6	760.0	838.4	858.4	833.4	810.9	794.1	782.1	
	Day of Week	TUE.	WED.	THU.	FRI.	SAT.	SUN.	MON.	TUE.	WED.	THU.	FRI.	SAT.	SUN.	MON.			
	Date	17	18	19	20	21	22	23	24	25	26	27	28	29	30			
Rainfall April 1990 (mm)		89.1	0.0	0.0	1.6	18.6	1.8	13.4	17.7	6.7	0.0	21.8	7.8	0.1	0.7			467.7
A: Effective Collection (m^3)		361.3	0.0	0.0	6.5	75.4	7.3	54.3	71.8	27.2	0.0	88.4	31.6	0.4	2.8			1,896.6
B: Water storage (m^3)	Surplus	336.3	−25.0	−25.0	−18.5	52.9	−15.2	29.3	46.8	2.2	−25.0	63.4	9.1	−22.1	−22.2			1,169.1
If 25 m^3/day is consumed	Accumulated surplus	1,118.4	1,093.4	1,068.4	1,049.9	1,102.8	1,087.6	1,116.9	1,163.7	1,165.9	1,140.9	1,204.3	1,213.4	1,191.3	1,169.1			1,169.1

A: Roof area 5,407.04 $mm^2 \times$ rainfall (mm) $\times 0.75 \times 0.001$

B: Working days = Effective water collected(A) − 25m^3

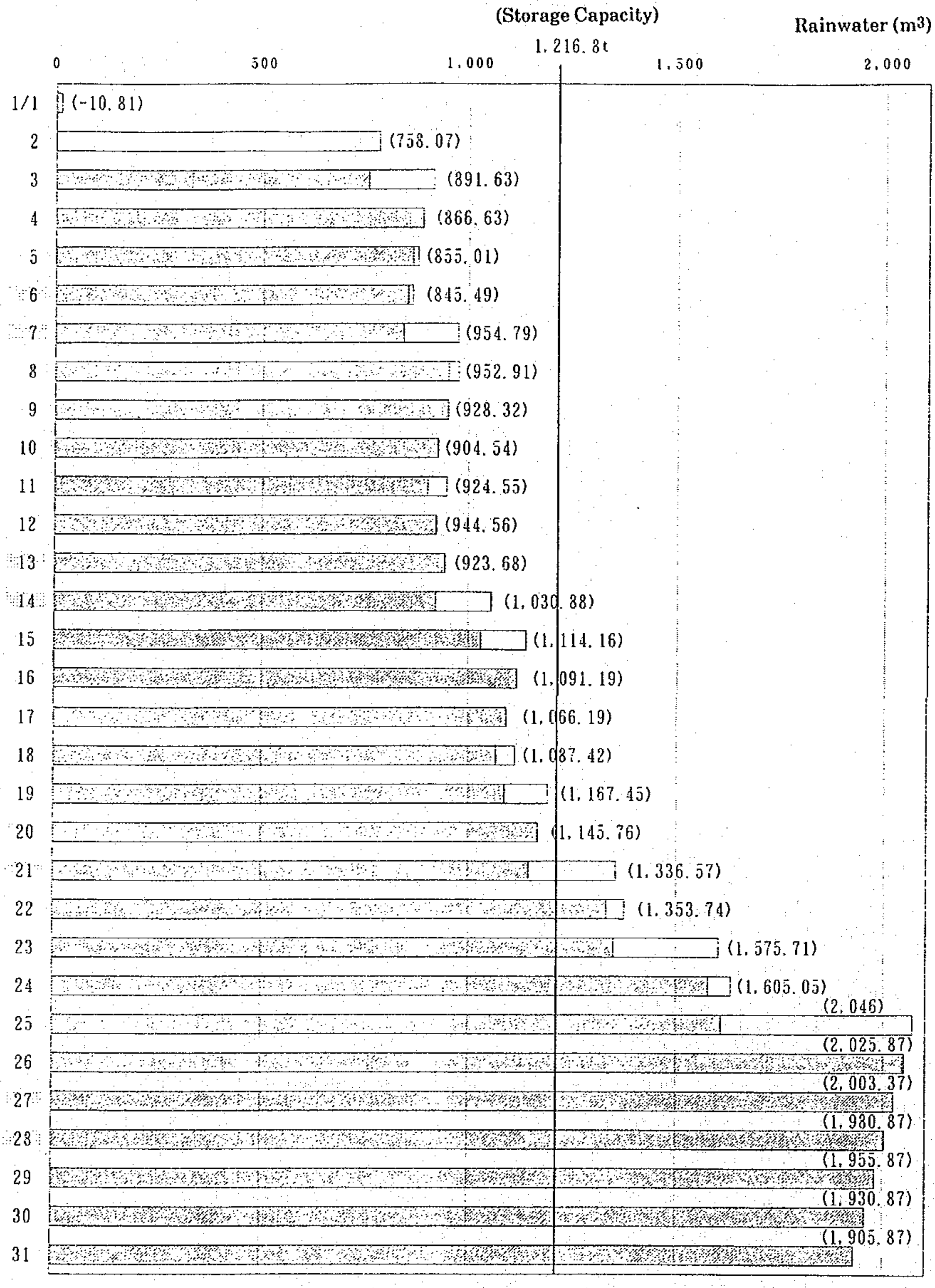
Holidays = Effective water collected(A) − 22.5m^3

Table 4-10 January 1990 Rainfall and Daily Surplus Rainwater
(Daily consumption: Working days, 25m³, Holidays, 22.5m³)



*( ) surplus rainwater

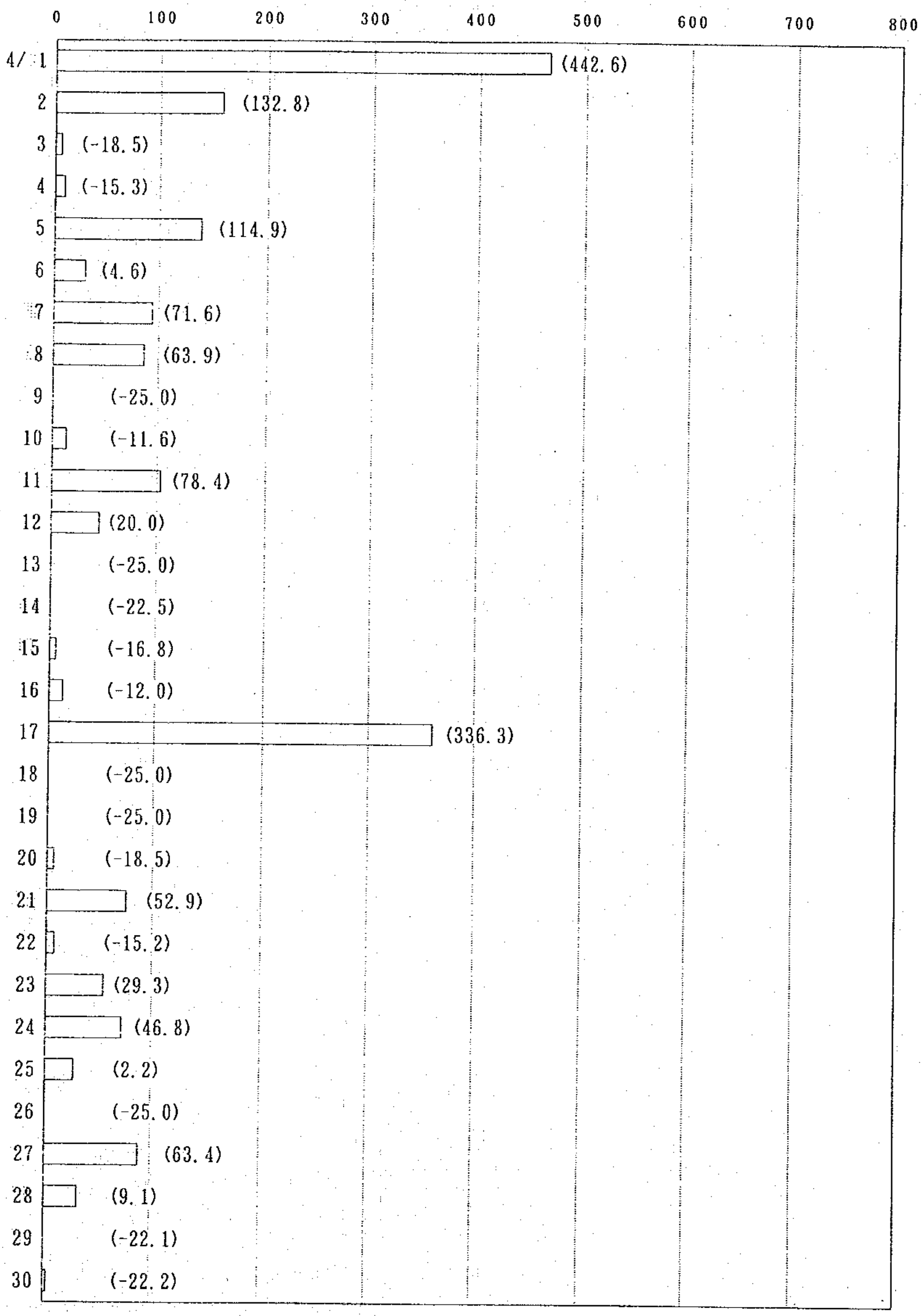
Table 4-11 Estimated Surplus Rainwater Based on January 1990 Rainfall and Daily Required Rainwater (Daily consumption: Working days, 25m³, Holidays, 22.5m³)



*( ) surplus rainwater

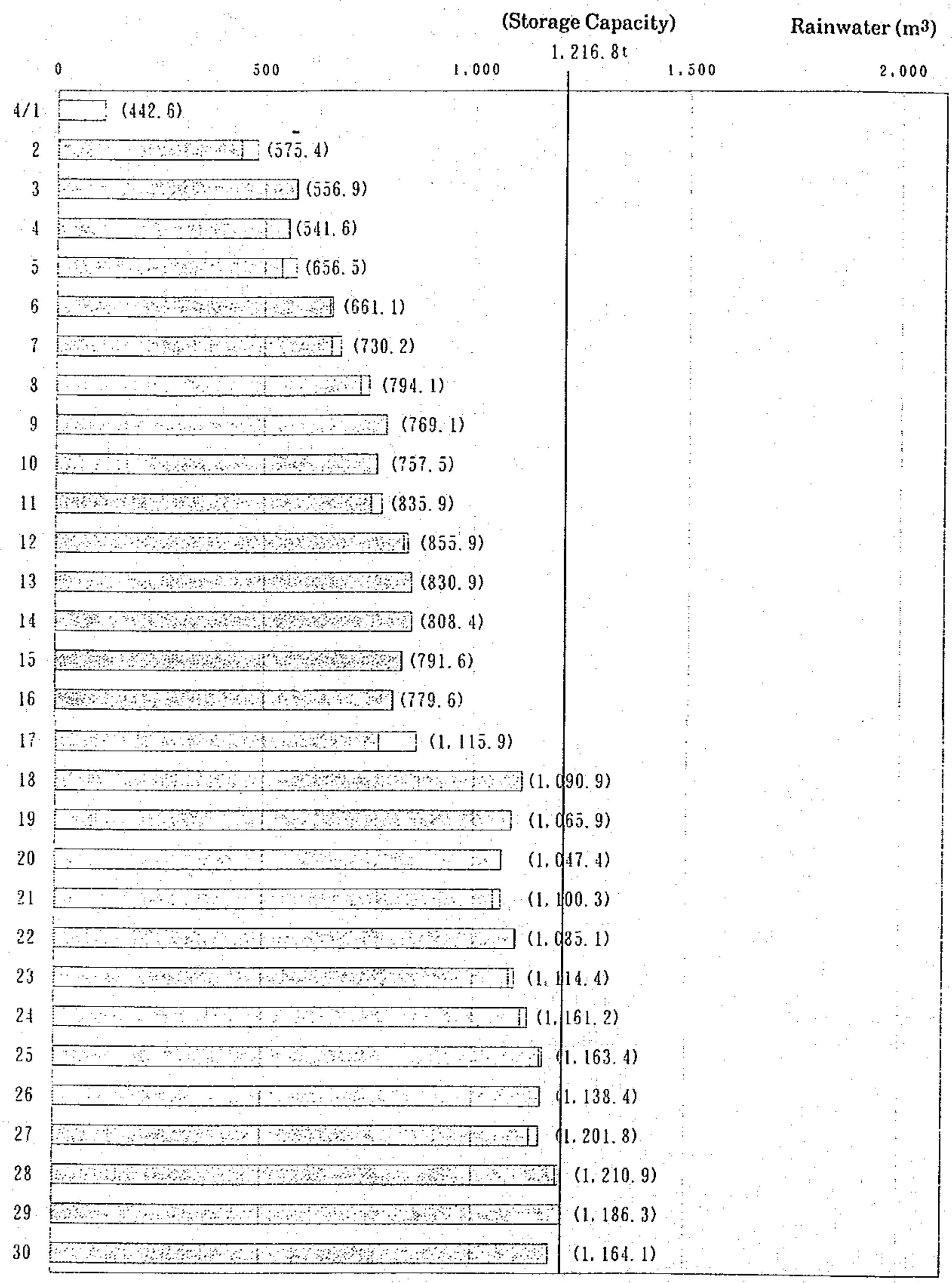
▩ is the previous day's surplus rainwater

Table 4-12 **April 1990 Rainfall and Daily Required Rainwater**
(Daily consumption: Working days, 25m³, Holidays, 22.5m³)



*( ) surplus rainwater

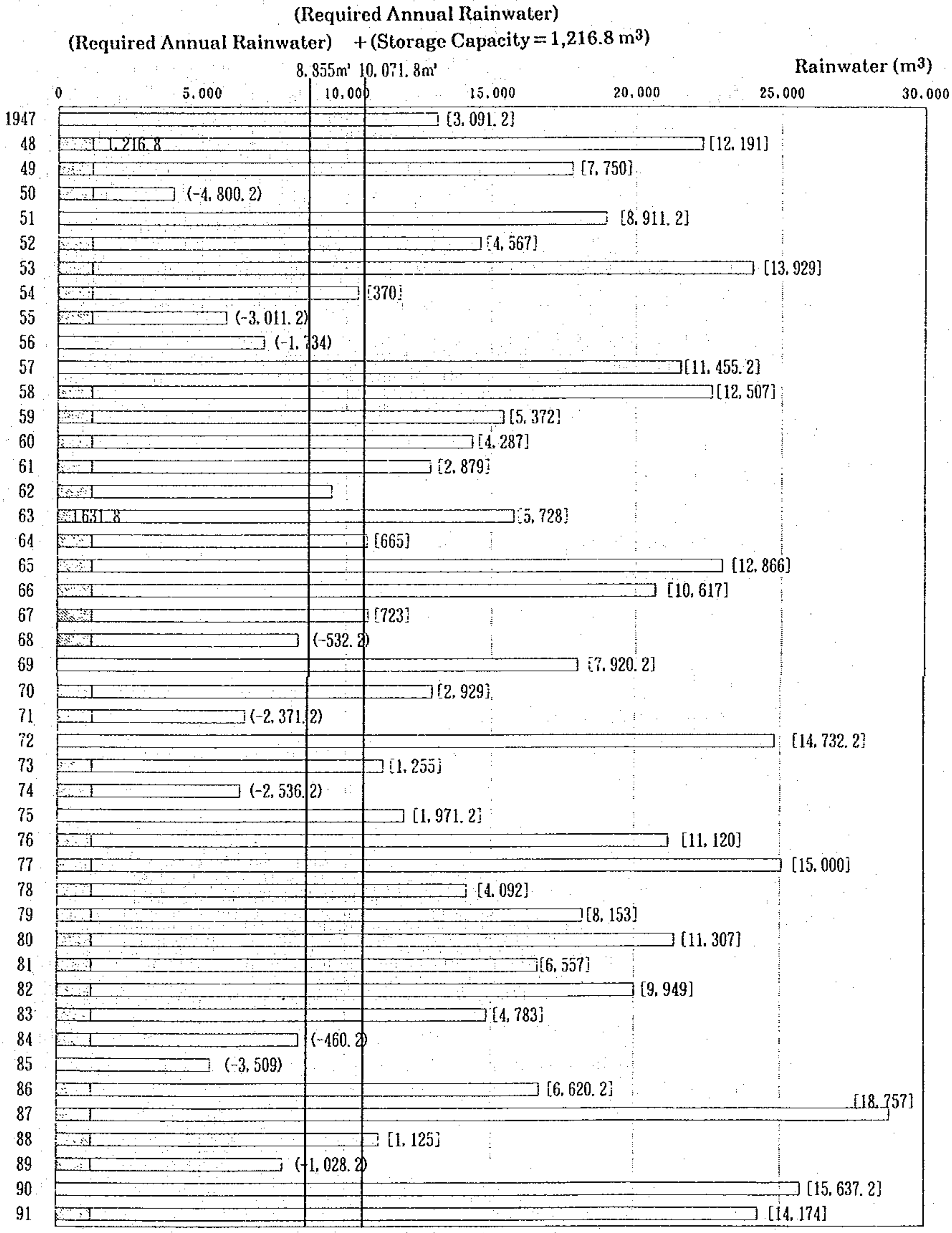
Table 4-13 Estimated Surplus Rainwater Based on April 1990 Rainfall and Daily Required Rainwater (Daily consumption: Working days, 25m³, Holidays, 22.5m³)



*( ) surplus rainwater

▩ is the previous day's surplus rainwater

Table 4-14 Supply Plans



▩ is the previous year's surplus rainwater
( ) shortages
[ ] amount of rainwater possible to supply to outside

Judging from Table 4-7, the maximum residual rainwater storage volume which is required for a steady supply of 25m^3/working day over 2 or 3 continuous low rainfall years is 6,496m^3. It appears inappropriate, however, to try to establish an effective water storage facility which is capable of storing 6,496m^3 on the premises under the Project due to the layout of the existing buildings on the project site, the existence of water supply and sewer networks as well as underground telephone and electricity cables, the soil conditions and other points of note discussed in 4-1 - Design Principles.

To be more precise, the construction of such an extensive water storage facility must take into consideration the (i) site limitations in view of the future site use plan, (ii) possible great distance between such a facility and the existing buildings, (iii) requirement to minimize the vibration, noise and dust, etc. caused by the construction work, (iv) avoidance of any disruption to the activities of the hospital due to re-routing of the existing building service networks, (v) need to minimize the construction period and (vi) need to minimize the operation and maintenance cost.

Consequently, an effective water tank storage capacity of 1,216.8m^3 appears appropriate as discussed in 4-2-6 - Determination of Scale of Facilities and Equipment and again in 4-3-1 - Site Layout Plan.

A feasible water supply plan must now be prepared based on this maximum rainwater storage volume of 1,216.8m^3. Assuming a supply of 25m^3/working day, this storage capacity must be fully utilized to deal with the water supply requirement for a low rainfall year (see Table 4-14). This plan cannot cover the demand for rainwater in an entire year if low rainfall continues for a few years. Nevertheless, Table 4-14 shows a great improvement in the rainwater supply situation compared to Table 4-4. Given the dismal prospect for an improved water supply on Tarawa Island described in 2-4 where tankers are used by the government to provide households with water during the dry season, it is possible (at least in theory) to provide surplus rainwater of slightly more than 100m^3/month to the neighbourhood, indicating the possibility of directly contributing to the improvement of local life. The prospect of distributing the surplus water to the neighbourhood can be determined based on the data given in Tables 4-9/14.

4-2-4 Utilization of Groundwater (Water Lens)

While there are two wells on the TCH premises at the sides of the Workshop and Nursing School, the latter is currently out of operation. Groundwater is pumped from the former and is directly supplied to the washbasins and showers of the wards and Maneaba. $40m^3$ of well water is currently supplied daily. As the TCH is built on a water lens area, the quantity of groundwater for extraction is sufficiently large. Excessive use for the municipal water supply in the past has resulted in the slight penetration of sea water but the water is still usable for washing, showers and preliminary washing at the Operating Theatre and Pharmacy if it is firstly treated through appropriate filtering and sterilization.

The Project envisages upgrading of the well to use the water for miscellaneous purposes and to supplement rainwater in low rainfall years while avoiding excessive use. In anticipation of an increased water demand in the future following the extension of the Dental Clinic and the General Ward and Psychiatric Ward Buildings currently planned by the TCH, the daily demand for well water is $50m^3$, $10m^3$ higher than the present supply level of $40m^3$. The storage capacity of the water tank for well water will be $100m^3$, equivalent to two days consumption. This well water will be pumped, filtered and sterilized for its use at various wards, Maneaba, Operating Theatre, Pharmacy and Dormitory of the Nursing School.

4-2-5 Utilization of Sea water

Sea water is currently pumped to an elevated water tank from where it is supplied to flush the toilets. However, the supply volume is inadequate vis-a-vis the increasing demand due to the expansion of hospital activities. The supply of additional sea water is possible by extending the intake further of the coast so that intake operation is extended to the low tide period instead of being limited, as at present, to the high tide period. Such extension, however, risks damaging the intake facility because of high waves. As a result, it is more appropriate to improve the pumping capacity and to introduce an additional storage tank. The storage capacity of the new tank is $20m^3$ in view of the future expansion of the TCH.

4-2-6 Scale of Facilities and Equipment

The location, scale and structure of the water tanks must be decided taking the TCH's future land use plan, existing building layout and possible impacts on both inpatients and outpatients into consideration. As the ground below 2.5m consists of hard coral rock, any deeper excavation work would require blasting, greatly disturbing hospital activities. The excavation depth is, therefore, restricted to up to 2.5m. The water tanks will be concealed underground in view of their posing an eye-sore and preventing natural ventilation if located above ground. Attention must be paid to arranging a uniform depth and similar roof area for rainwater collection/water tank as much as possible in deciding the rainwater distribution system from the building roofs. Moreover, the present state of such underground structures as water supply and sewer pipes and telephone and electricity cables, etc. must be carefully considered. Based on these requirements, the scale of the water tanks to be installed is planned as shown in Table 4-15.

Table 4-15 List of New Water Tanks

	Tank No.	Surface Area (m^2)	Effective Depth (m)	Cubic Size (m^3)	Effective Storage Capacity (A) (m^3)	Roof Area (B) (m^3)	A/B	Place of Use
Rainwater Tanks for Hospital Use	1	160	2	320	288	536.64	0.54	Kitchen, Blood Bank
	2	300	2	600	540	-	-	Regulating Water Tank
	3	50	2	100	90	1,196.52	0.08	Administration & Education Buildings
	4	50	2	100	90	1,046.16	0.09	Nursing School, Dormitory
	5	50	2	100	90	1,095.32	0.08	Wards
	6	50	2	100	90	1,186.08	0.08	Wards
	Sub-Total	660	-	1,320	1,188	5,060.72	0.23	-
Rainwater Tanks for Maneaba	7/10	4×4=16	2	32	28.8	346.32	0.08	Maneaba
Rainwater Tank Total	-	676	-	1,352	1,216.8	346.32	0.08	Maneaba
Well Water Tank	11	50	2	100	90	-	-	-
Sea water Tank	12	40	2	80	72	-	-	-

4-3 Basic Plan

4-3-1 Layout Plan (Rainwater Collection Zoning Plan)

The new underground water tanks will be located at 7 sites: (1) flower bed to the east of the North Front Gate, (2) between the Medical Ward and Surgical Ward, (3) between the Pediatrics Ward and Obstetrics Ward, (4) south side of the Nursing School Dormitory, (5) next to the existing water tank/elevated water tank, (6) next to the Maneaba Building and (7) next to the existing well. Points to note regarding these locations are given below.

With regard to location (1), a soil cover of 20-30cm in thickness will be added for the growing of plants. Locations (3), (4) and (5) are currently used as a recreation ground for student nurses. A concrete ground cover of some 15cm in thickness will be provided above the tanks for continued use as a recreation ground. As the water tank at location (7) will be placed above ground, the plan should allow space for the future extension and provision of adequate ventilation for the Maneaba Building. All the water tanks should be at a distance of a least 3m from the existing buildings and the maximum excavation depth is 2.5m. Each tank will have approximately the same roof area for rainwater collection in view of the efficient operation of each tank. The distance between the roof and tank will be less than 70m and the crossing over of existing building service pipes will be avoided. The location of each water tank and the corresponding rainwater collection roof area, determined based on the aforegoing discussions, are shown in Fig. 4-1.

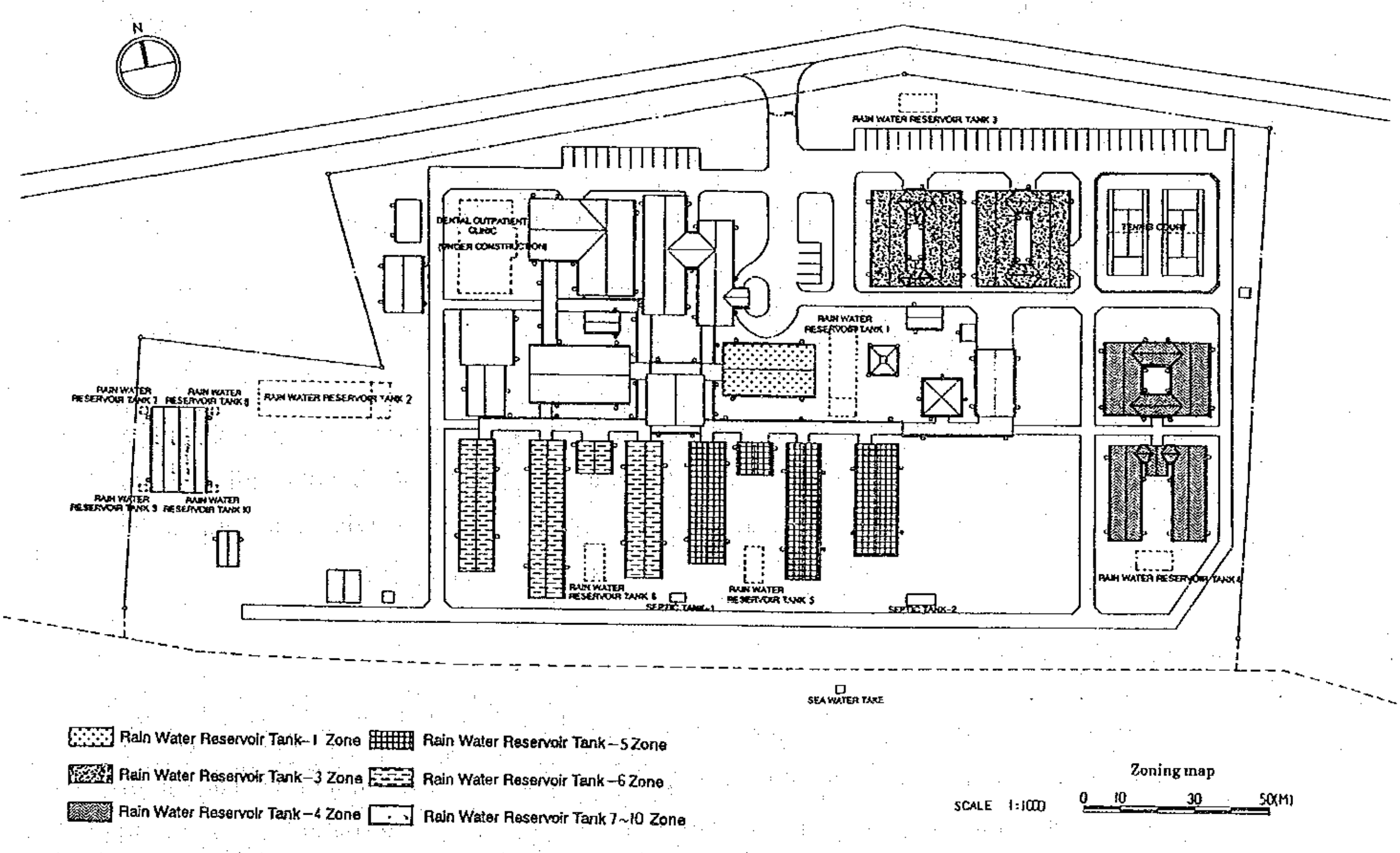


Fig. 4-1 Water Tank Locations

4-3-2 Facility Plan

(1) Building Components Plan

In planning the building components, it is necessary to take the characteristics of the local climate, i.e. strong ultraviolet rays, high temperatures, high humidity, sandy winds and salt damage, into consideration. Maintenance-free features are preferable together with both rust and dust prevention measures. Energy-saving is also another important consideration.

Water tanks made of concrete blocks which are popularly used in Kiribati are, in fact, unsuitable in view of their waterproofing and durability performance and the use of reinforced concrete is instead planned. A steel-frame structure is inferior to a reinforced concrete structure in terms of resistance to salt and maintenance.

Based on the above observations, the following building components are planned.

1) Eave Gutters

The material for the gutters to collect rainwater will be galvanized steel (also used for the roofs) to avoid electrolytic corrosion between different metals.

2) Vertical Conduits

Vinyl chloride pipes will be used in view of their good weatherability and workability.

3) Underground Water Tanks

Highly waterproof, reinforced concrete will be used for the construction of the underground water tanks in view of resistance to water, chlorine and salt and also in view of durability. While no special waterproofing layer will be provided, the inclusion of admixture is designed to give a waterproofing feature.

(2) Structural Plan

The cement used for the concrete structures will be ordinary Portland cement. A batcher plant will be constructed on-site for the preparation of raw concrete. The use of an anti-corrosion agent is planned as the fine aggregates include materials containing salt, such as sea sand.

A flat slab structure will be adopted for the water tanks to facilitate the construction work. The geological composition of the construction sites consists of surface soil of crushed coral sand upto a depth of approximately 2.5m with very hard coral rock below. This hard coral rock is believed to have sufficient bearing strength to act as the direct foundation to support the water tanks. Given the relatively high normal groundwater level, it is necessary to prevent the floating of the water tanks due to the buoyancy of the groundwater while making the bottom plate of the water tanks as thin as possible to minimize the excavation of hard coral rock. The TCH premises are located along the coast and measures to prevent salt damage to the reinforced concrete structures are essential. One such measure is the introduction of a concrete thickness of more than 50cm surrounding the structural steel.

(3) Utilities and Plumbing Plan

The following two principles must be upheld in the planning of Project-related utilities and plumbing work.

<u>Principle 1: Minimization of Operating Cost</u>

The systems and equipment must be selected on the basis of the following criteria to minimize the electricity cost.

i) Selection of low energy consumption equipment (low energy loss type)
ii) Simplification of systems

<u>Principle 2: Minimization of Maintenance Cost</u>

The equipment and pipes, etc. must be selected on the basis of the following criteria to minimize the maintenance and repair cost.

i) Exclusion of equipment composed of complicated parts (electric circuit boards, etc.)
ii) Selection of equipment and materials which are readily available
iii) Emphasis on the application of the same standards and also on compatibility
iv) Easy maintenance
v) Avoidance of corrosion due to salt

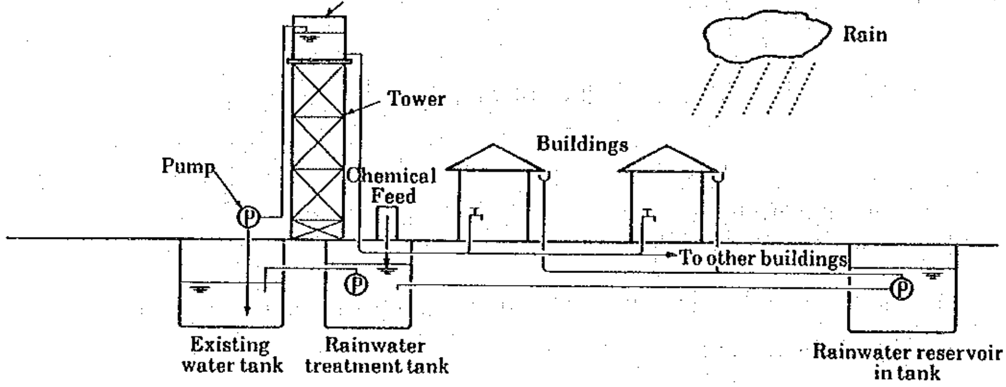
The utilities and plumbing work for the Project are planned on the basis of these criteria.

1) Water Supply Facilities

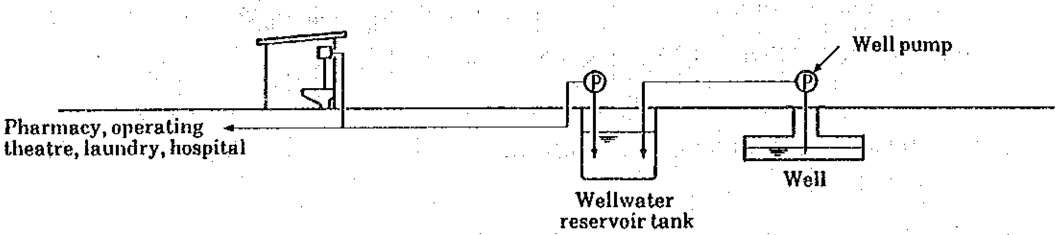
The existing water supply facilities of the TCH receive municipal water which is pumped to an elevated water tank from primary water storage tanks and then distribution to each building using the gravity system.

The rainwater collected from the roofs will initially be stored in the new water tanks and will then be sent to the existing water tanks after sterilization to use the existing distribution system.

Well water from the existing well will be stored in the new well water storage tank and distributed to the buildings through a different system to the service water distribution system described above for miscellaneous purposes. These systems are illustrated in Fig. 4-2.



Rainwater Supply Facility System Drawing (1)



Wellwater Supply Facility System Drawing (2)

Fig. 4-2 Water Distribution Systems

2) Generator

A diesel engine-powered generator will be installed as an emergency power unit to support the water supply. The generator will be an indoor, radiator-cooling type with 3-phase, 4-wire, 240/415V, 50Hz and 75KVA. The oil tank will be sufficiently large enough to support more than 30 hours operation. The system will be automatically switched on whenever there is a failure of the main power supply.

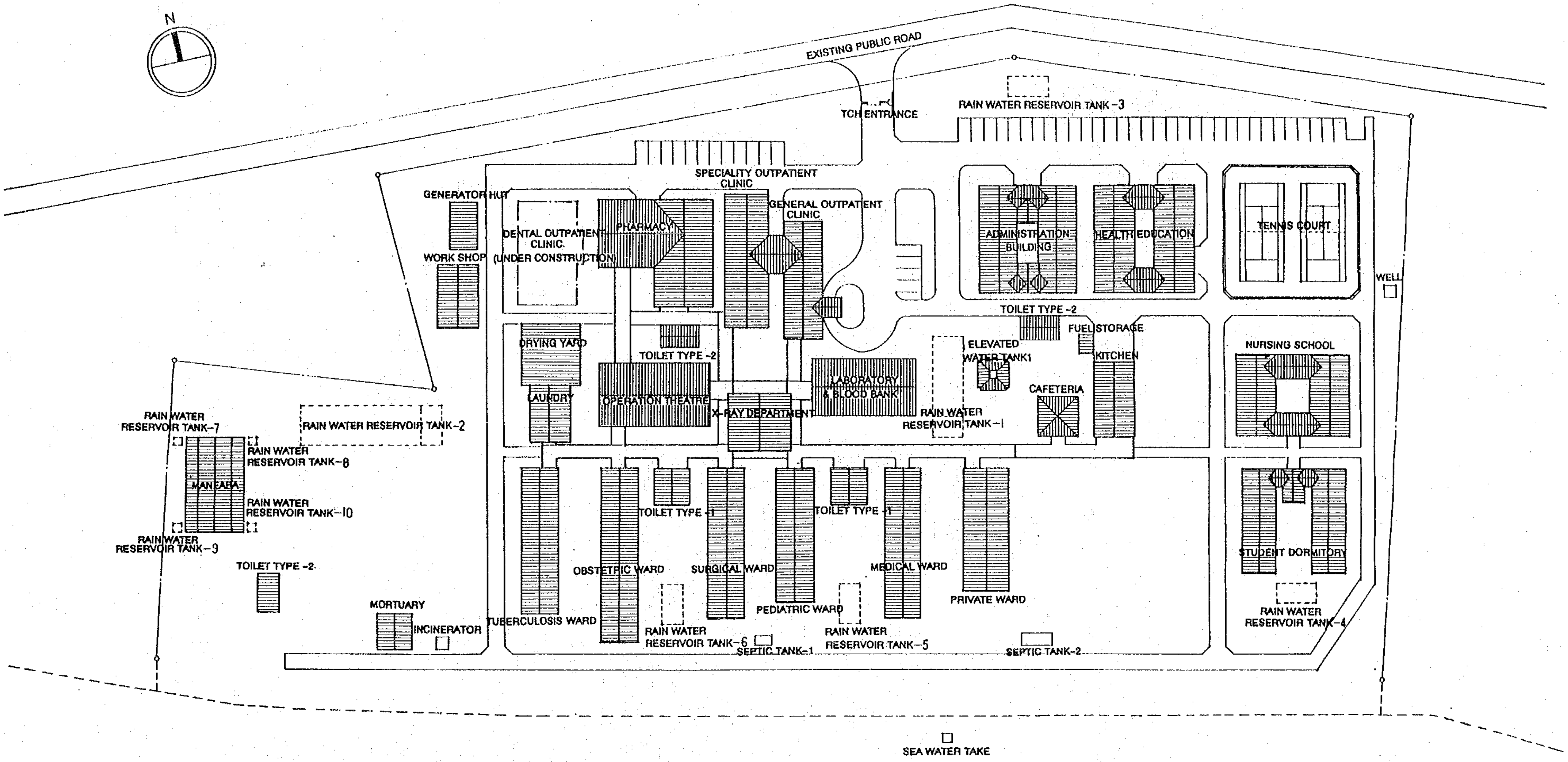
3) Power Distribution

Given its outdoor installation, a salt-resistant type power distribution board will be selected for the various pumps.

4-3-3 Basic Design Drawings

(Facilities)

(1) Layout
(2) Water Storage Tanks
(3) Trunk Water Distribution System - 1
(4) Trunk Water Distribution System - 2
(5) Power Distribution System



SITE PLAN

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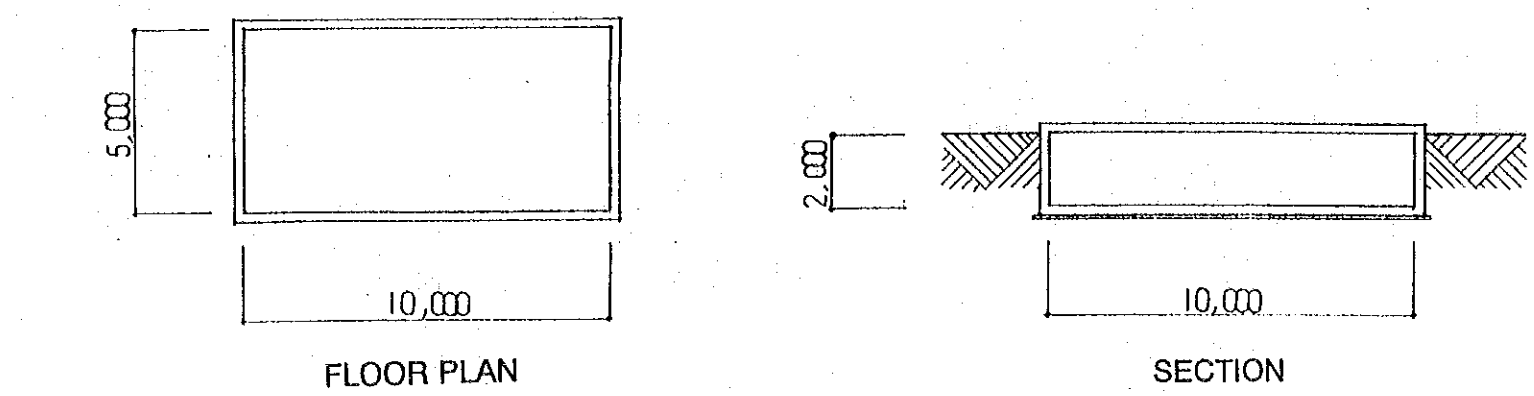
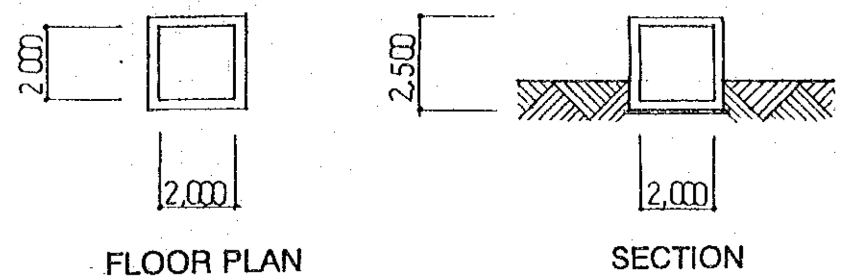
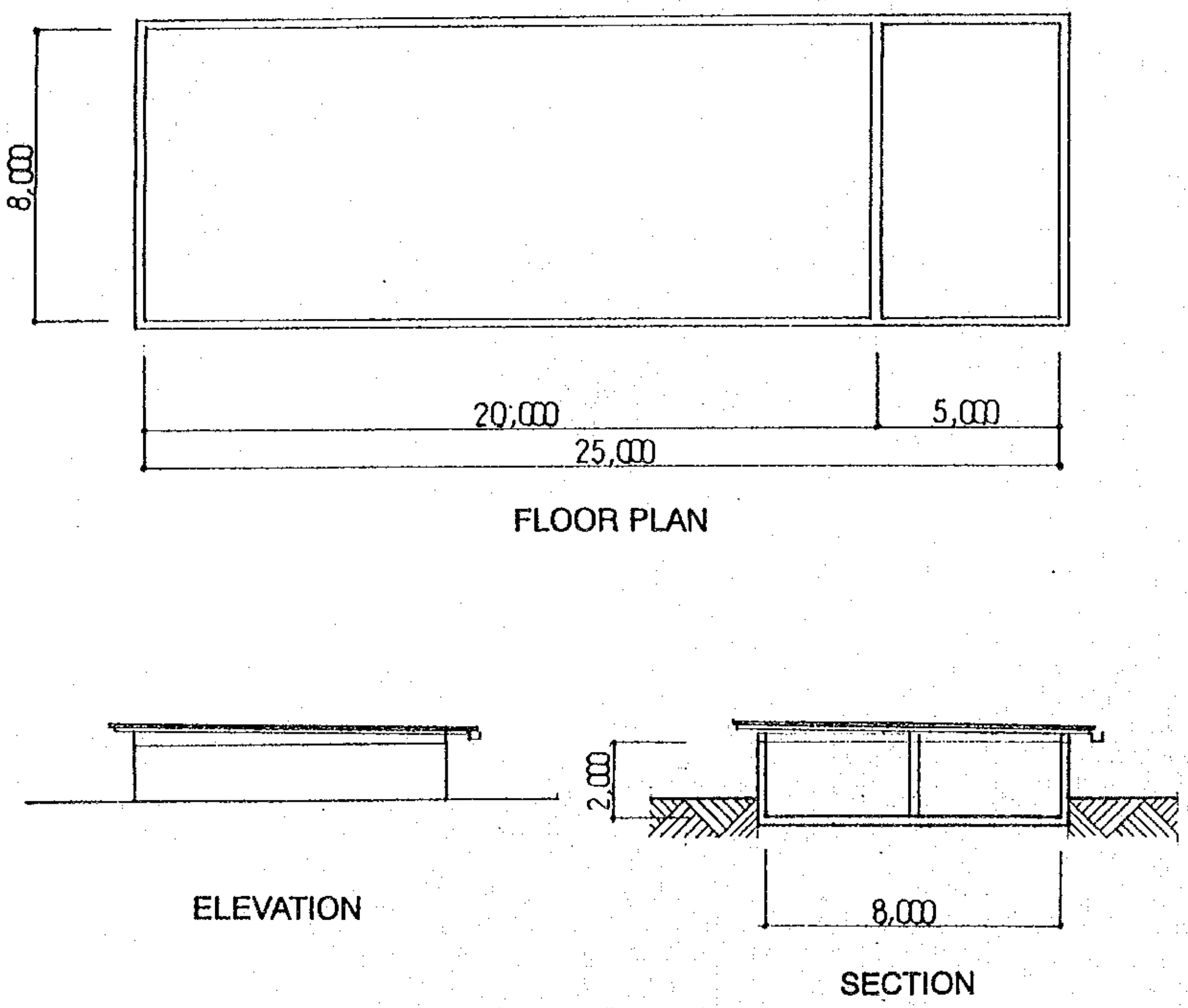


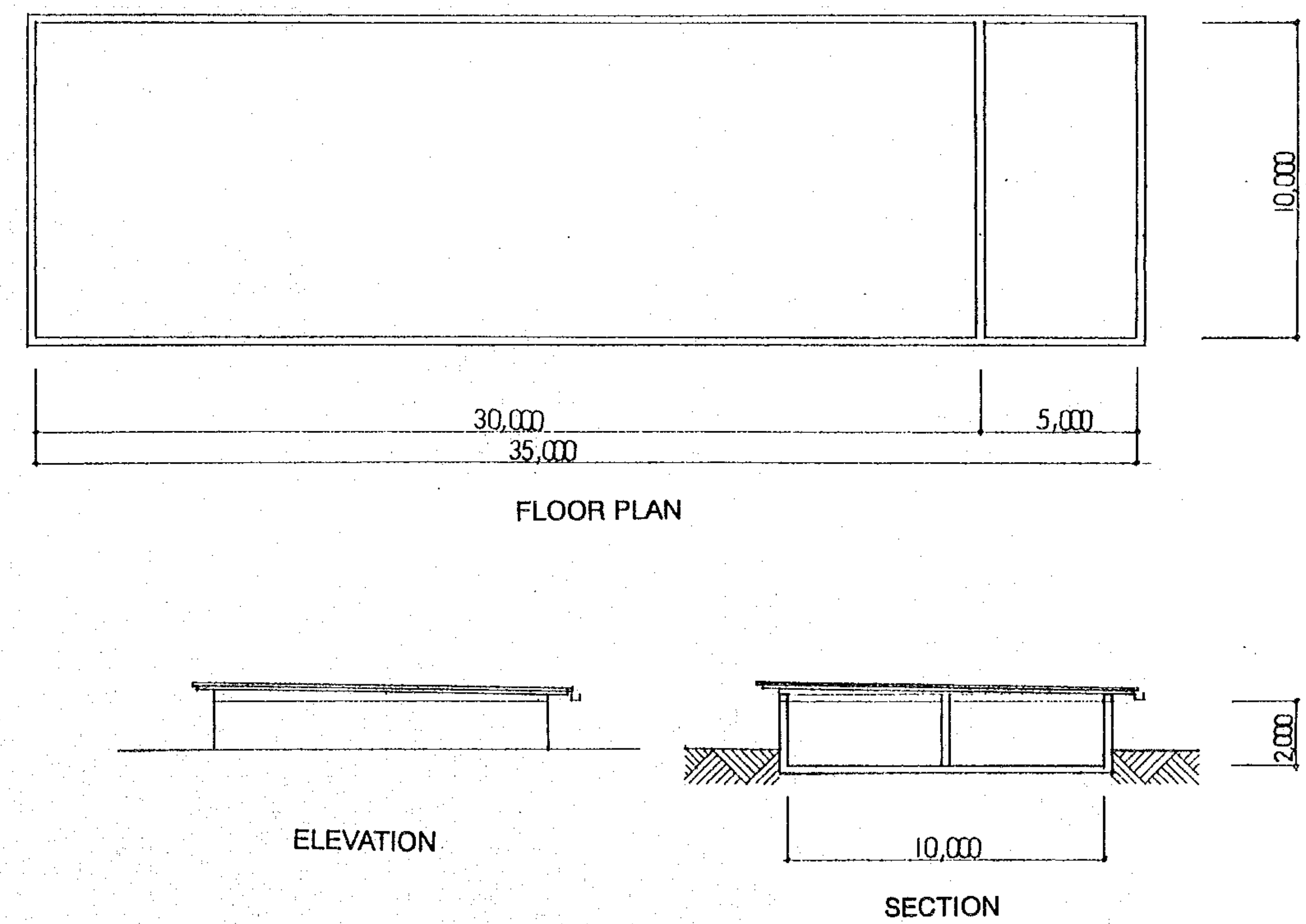
RAIN WATER RESERVOIR TANK —3,4,5,6



RAIN WATER RESERVOIR TANK —7,8,9,10



RAIN WATER RESERVOIR TANK —1



RAIN WATER RESERVOIR TANK —2

RAIN WATER RESERVOIR TANK

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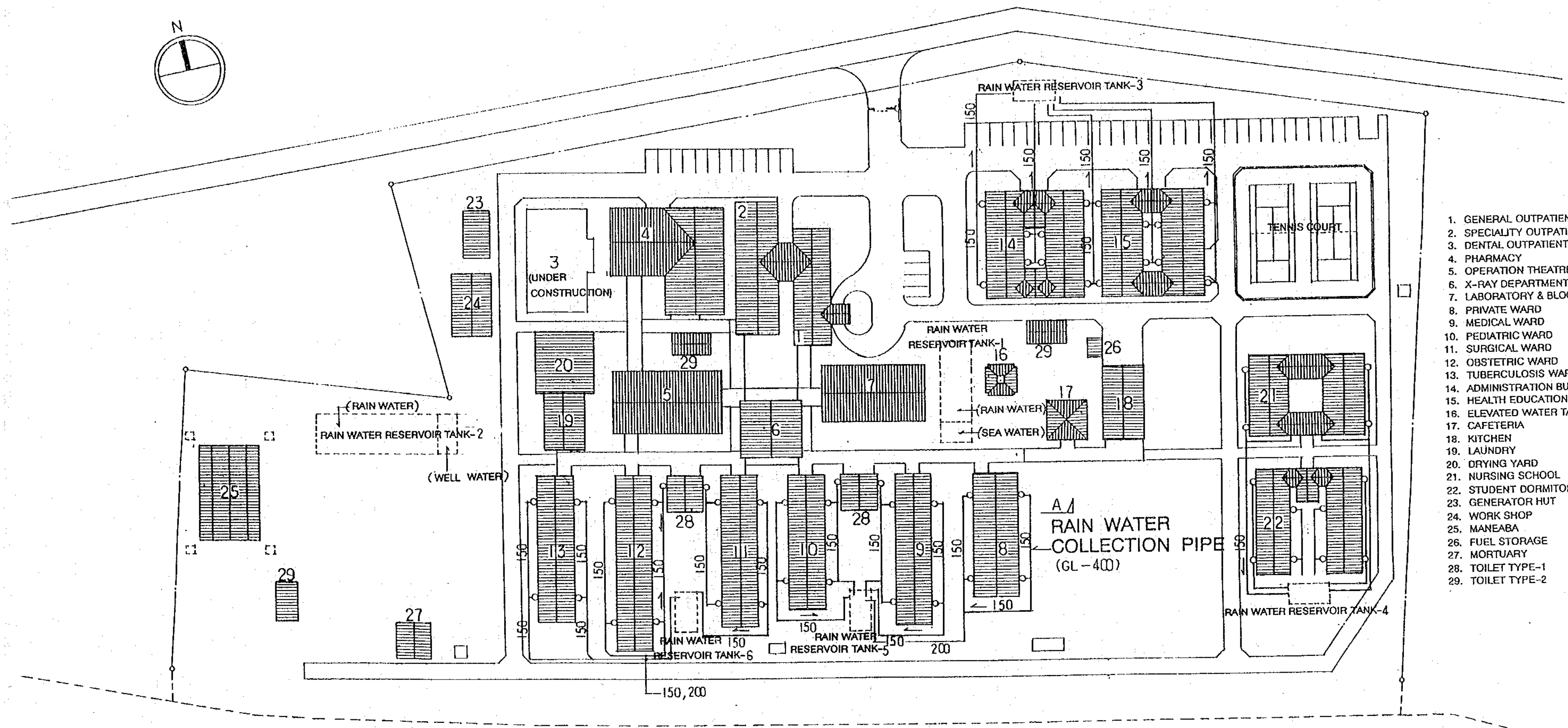

1. GENERAL OUTPATIENT CLINIC
2. SPECIALITY OUTPATIENT CLINIC
3. DENTAL OUTPATIENT CLINIC
4. PHARMACY
5. OPERATION THEATRE
6. X-RAY DEPARTMENT
7. LABORATORY & BLOOD BANK
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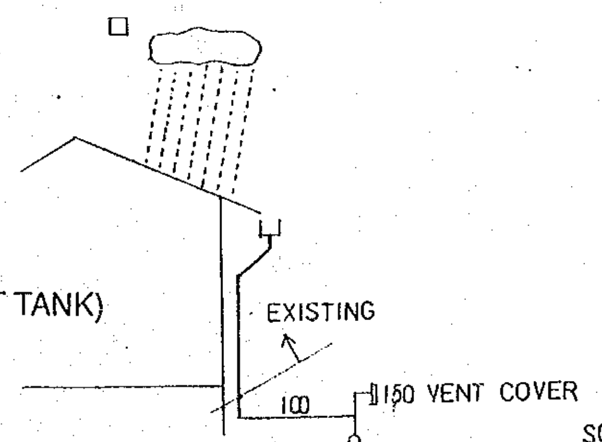
11. SURGICAL WARD
12. OBSTETRIC WARD
13. TUBERCULOSIS WARD
14. ADMINISTRATION BUILDING
15. HEALTH EDUCATION
16. ELEVATED WATER TANK 1
17. CAFETERIA
18. KITCHEN
19. LAUNDRY
20. DRYING YARD
21. NURSING SCHOOL
22. STUDENT DORMITORY
23. GENERATOR HUT
24. WORK SHOP
25. MANEABA
26. FUEL STORAGE
27. MORTUARY
28. TOILET TYPE-1
29. TOILET TYPE-2

—— Rain Water



A-A SECTION

RAIN WATER COLLECTION SYSTEM
(FROM RAIN WATER RESERVOIR TANK TO FINAL TREATMENT TANK)

WATER SUPPLY SYSTEM-1

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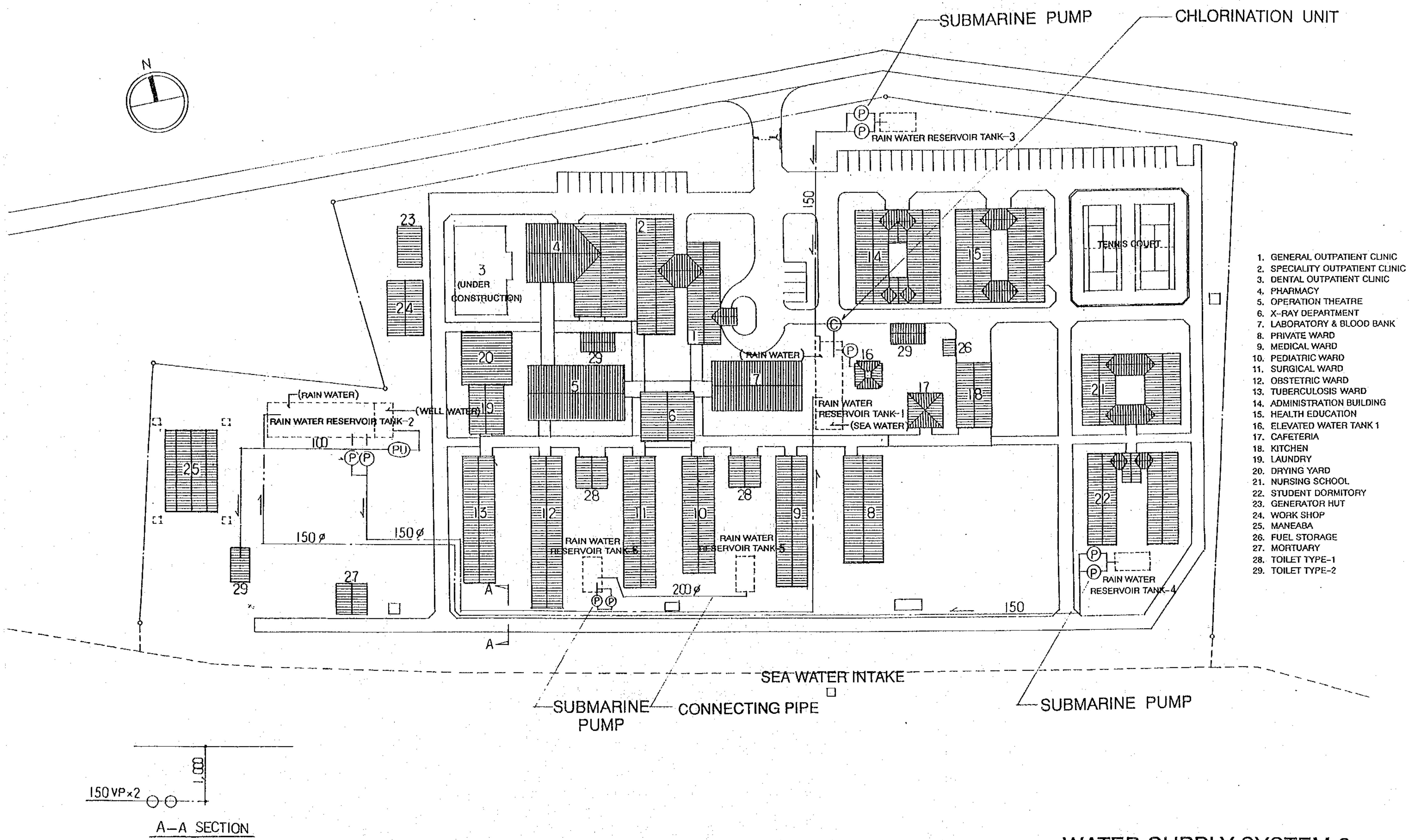
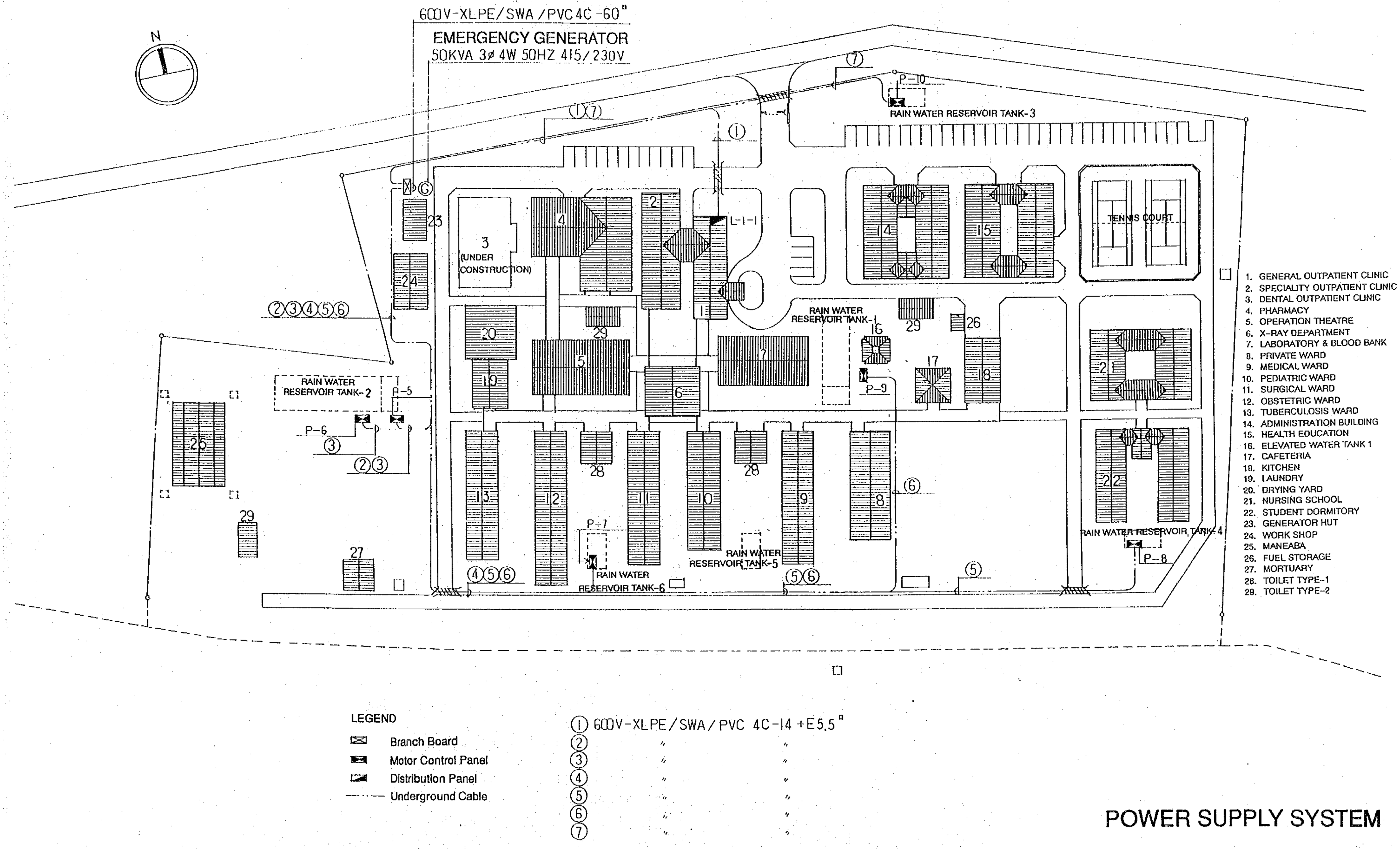


WATER SUPPLY SYSTEM-2



POWER SUPPLY SYSTEM

SCALE 1:1000 0 10 30 50(M)

4-4 Execution Plan

4-4-1 Execution Policy

(1) Project Execution System

In the case of the Project being executed with Japanese grant aid, the agency responsible for the Project on the Kiribati side will be the Ministry of Foreign Affairs. While the main project execution organization will be the Ministry of Health and Family Planning, the Ministry of Home Affairs, Ministry of Finance, Ministry of Trade, Industry and Labour, Ministry of Works and Energy and Ministry of Transportation and Communications will also share the responsibility for the execution of the Project. The area of responsibility of each ministry is shown in Table 4-16.

Table 4-16 Area of Responsibility of Each Ministry

Ministry	Responsibility
Foreign Affairs	negotiations for grant aid, signing of E/N
Health	execution of Project, signing of contracts
Home Affairs	provision, surveying and preparation of project sites
Finance	handling of B/A and A/P, appropriation of project-related budget
Works and Energy	provision of electricity and water supply to site
Trade, Industry and Labour	provision of construction engineers and materials
Transportation and Communications	import and export procedures

While the medical service system is as already shown in Fig. 2-2, the Chief Medical Officer will be responsible for project execution and will smoothly execute the Project under the supervision of the Health Secretary.

(2) Scope of Construction Work

The scope of the construction work for the Japanese and Kiribati sides is shown in Table 4-17.

Table 4-17 Work Assignment

		Japanese Side	Kiribati Side
Main Work	Land Preparation & Exterior Work	rehabilitation of roads & car parks around project sites	completion of land preparation, felling of trees & uprooting prior to commencement of construction work
	Water Supply	construction of water storage tanks, pumping facilities & elevated water tank, water distribution system to planned facilities	
	Drainage	construction of drainage facilities for planned facilities	
	Electricity	installation of electricity supply facilities, including self-generating unit & substation, to planned facilities	
Facilities		construction of all facilities listed in 4.2 & all ancillary facilities	construction of necessary facilities other than those to be constructed by Japanese side
Equipment & Materials		provision & installation of planned equipment & operation guidance	
Transportation of Equipment & Materials		packing of equipment & materials to be shipped from Japan, insurance premium payment, all necessary work involved in transportation of equipment & materials to Port Besio & further to project site	customs clearance of equipment & materials at port of arrival, exemption from all taxes and acquisition of import permits for equipment & materials
Work Relating to Project Execution			bank arrangements & payment of bank costs, provision of all conveniences & exemption from duties & domestic taxes for consultants and contractor's staff in connection with their travel to & from & stay in Kiribati

(3) Construction Policy

Neither construction consultants nor construction companies are available in Kiribati. Apart from small-scale construction work conducted by the PUB or PWD, all types of construction work are conducted by foreign companies. As a result, there are few construction technicians which are generally trained at the Tarawa Institute of Technology run by the Ministry of Trade, Industry and Labour. All engineers in Kiribati are registered with the Bureau of Labour and are classified into such job categories as foreman, artisan (3 grades each for carpenters, brick masons and electricians), clerk, salesman, serviceman (police officer and fire-fighter) and fisherman, etc.

The registered number of construction-related technicians and those on the current job application list are shown in Table 4-18.

Table 4-18

(in 1987)

Job Type	Number of Registered Technicians	Number on Job Application List
Foreman	9	1
Machine Watcher	2	2
Artisan	65	2
Equipment Foreman	2	1

While many construction workers are available, the technical level is generally low and there is a definite shortage of skilled workers.

Supervisors will be recruited from third countries to oversee the technical skills and work of the local workers in order to ensure acceptable work results for the Project. A Japanese technician will be dispatched as a supervisor for the installation of the generator.

4-4-2 Conditions of Local Construction Industry and Points to Note

Kiribati is dependent on imports for most construction materials as few are produced locally. Accurate identification of the time required for the procurement of such materials, i.e. from order placement to delivery, is essential as the local shipping schedule is not totally reliable. The construction plan for the Project must be prepared with due reference to the work capability of local workers, the time required to procure construction equipment and materials from abroad and the local weather conditions. The work schedule should then be prepared in accordance with the construction plan.

4-4-3 Work Supervision Plan

Following the conclusion of the construction contract for the Project, the chief engineer of the Japanese consultant will visit the project site, give instructions on the construction work to the building contractor and discuss and confirm the work schedule with them. The chief engineer will also complete the necessary procedure to commence the construction work. Upon commencement of the construction work, the chief engineer and those responsible for the structures and facilities will visit the project site for spot inspection and supervision of the work and will report on the work progress to the Embassy of Japan in Fiji, the JICA Fiji Office and the competent authorities of the Government of Kiribati. Their assignment also includes coordination between all parties involved in the Project and the establishment of a precise understanding of the work to facilitate its smooth execution. In practice, they will supervise the progress of the construction work, taking the skill level of local workers into consideration and paying proper attention to the local climate, customs and institutions in Kiribati. The purpose of work supervision is to ensure the smooth progress and high quality results of the work and the completion of the work in accordance with the schedule. In the preparation of the execution plan, the work schedule must be carefully prepared in detail, taking the local construction skills and the time required to obtain equipment and materials from Japan into consideration.

The supervisory work during the construction period will consist of the following duties.

(1) Advice and Guidance on Construction Contract

Screening of the qualifications of participating tenderers, tender preparation and execution, evaluation of the details of tender documents, selection of construction contractor and witnessing of the signing of the construction contract.

(2) Inspection and Approval of Working Diagrams, etc.

Inspection and approval of the contractor's working diagrams, sample materials, mechanical systems and equipment.

(3) Guidance on Work and Inspection

Examination of and provision of guidance on the execution plan and work processes, follow-up and provision of guidance on work progress and necessary work inspection during the construction period.

(4) Approval of Payment

Inspection and confirmation of the completed parts of the construction work in regard to making the relevant payments during and upon completion of the work and the issue of approval notes for payment.

(5) Work Progress Report

Submission of periodical reports on the construction progress to the execution organization (Ministry of Health and Family Planning) and competent authorities of the Government of Japan in order to contribute to the smooth progress of the assigned work of both the Government of Japan and the Government of Kiribati.

(6) Handing Over of Facilities and Equipment

Confirmation of the fulfillment of the contract provision upon the completion of construction, witnessing of the handing over of the facilities and equipment based on the contract and completion of the assigned supervisory work with the receipt of acceptance issued by the execution organization.

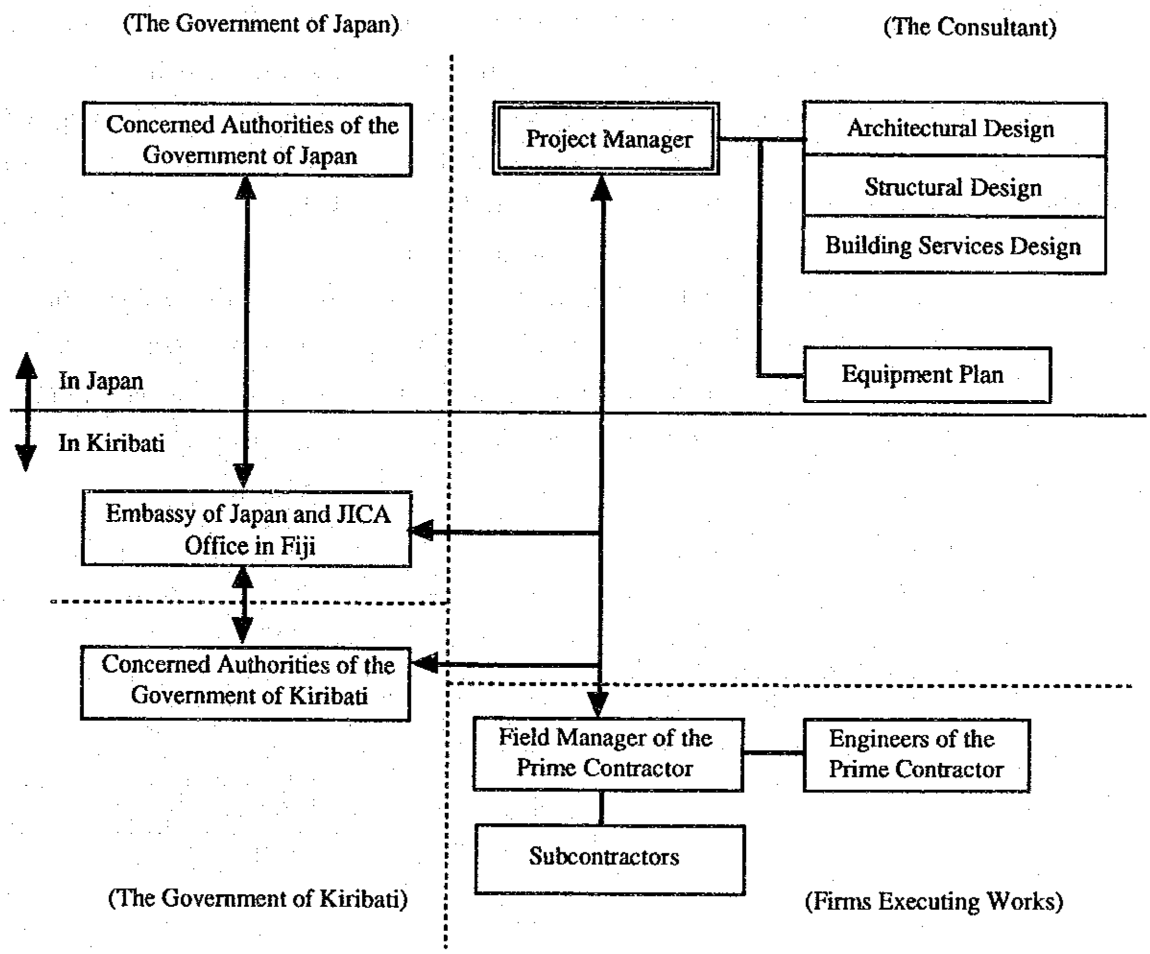


Fig. 4-3 Organization Diagram for Execution

4-4-4 Procurement Plan for Equipment and Materials

Of the construction materials required for the construction work under the Project, only crushed stones, sand and concrete blocks can be locally procured. All equipment and materials for the building services must be imported. The Supply Division of the Ministry of Trade, Industry and Labour of the Government of Kiribati imports all materials for the construction of government facilities and for their sale in the private sector. The Division always carries some stock. It imports to order whatever materials are in short supply and sells them at a price arrived at by adding a handling charge to the procurement, transport and customs clearance costs. As infrastructure development projects in Kiribati are implemented with the ODA and guidance of Australia and the United Kingdom, almost all equipment parts for such building services as piping, lighting fixtures, switches and sanitary fixtures are regulated by Australian standards. Consequently, the equipment and fixtures, etc. required for the Project for the connection with trunk lines will be imported from Australia to ensure a ready supply of spare parts. Construction materials will be procured in Japan. Items to be imported from third countries will be procured through the Supply Division.

Table 4-19 Planned Supply Sources for Construction Equipment and Materials

	Kiribati	Japan
Building-Related Items	crushed stones, sand, concrete blocks	reinforcing bars, plywood for framework, caulking compound, iron plates, manhole covers, grating, heat insulation materials, cement, paint
Building Service-Related Items		power distribution board, generator, some lighting fixtures, wiring materials, pipes, water pumps

4-4-5 Implementation Schedule

The detailed design work and execution supervision for the Project will be conducted by a Japanese consultant. Under the supervision of this consultant, a Japanese company will procure the construction materials, undertake the construction of the facilities, manufacture, procure, transport and install the equipment and mechanical systems and conduct all other work necessary to materialize the Project under the general contracting system. The implementation of the Project will be conducted under the control of the Government of Kiribati in compliance with the grant aid procedure of the Government of Japan.

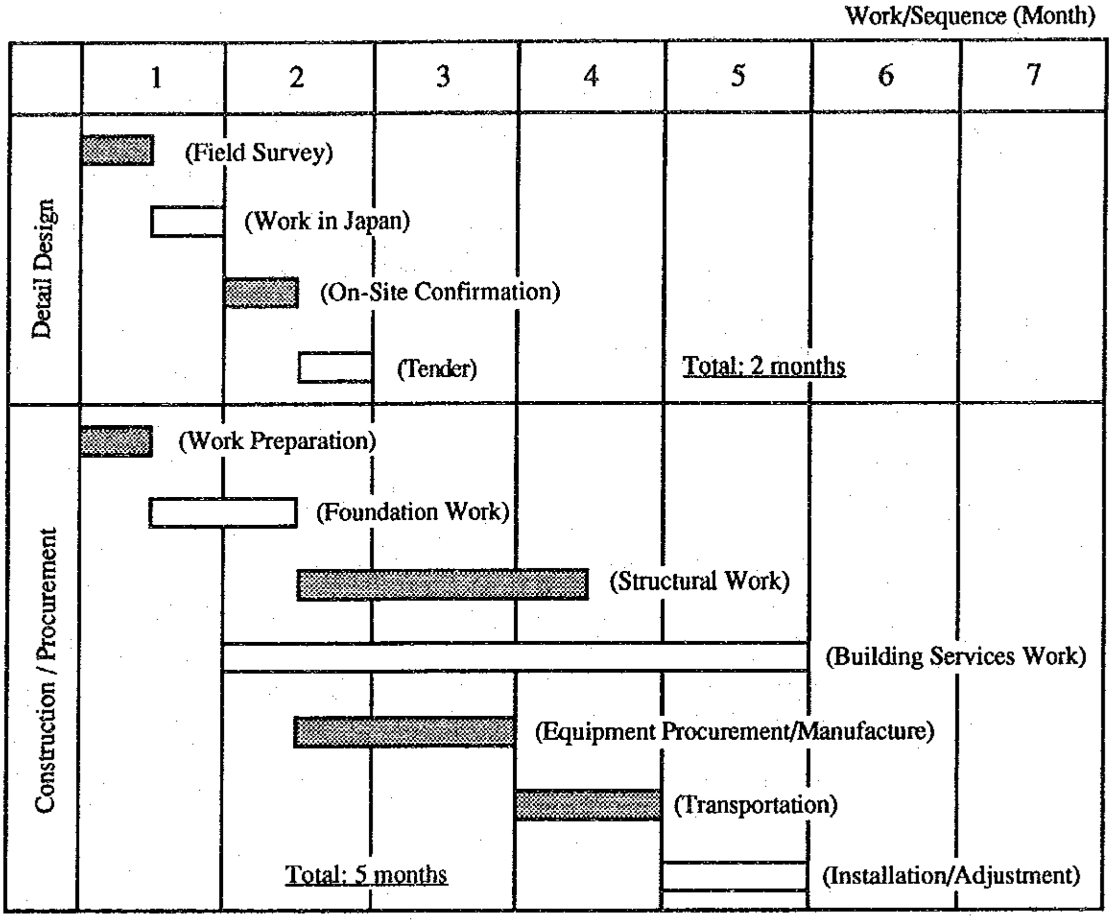
Following the signing of the E/N for the grant aid between the Government of Japan and the Government of Kiribati, the consultant will conclude a consultancy contract with the Ministry of Health and Family Planning of the Government of Kiribati (the execution organization) and will start preparing the tender documents for the detailed design.

The detail design work will require one month, the details of which will be agreed through consultations with the Government of Kiribati. Upon completion of the tender preparation, the contractor will be selected through the tender process. The successful bidder will have the breakdown of his tender price examined and, upon receipt of confirmation of its propriety, will conclude a contract for the work with the execution organization. The period required for this tender procedure is approximately one month.

Following the signing of the contract by and between the Government of Kiribati and the successful bidder, the contract will then be verified by the Government of Japan, upon which the procurement of construction materials and the manufacturing of equipment and mechanical systems will commence. Prior to commencing work, the contractor must prepare the detailed drawings and obtain their approval from the consultant.

Five months will be required from the time of commencing the work to manufacture, procure, install and test the construction equipment and materials to the handing over of the facilities and equipment envisaged under the Project to the Government of Kiribati.

Table 4-20 Project Execution Schedule



4-4-6 Approximate Project Cost

Assuming that the Project is basically executed with Japanese grant aid, the Government of Kiribati is expected to bear the following Project-related cost.

- Landscaping : 1,500 A$ (approximately 140,000 yen)

CHAPTER 5

POSITIVE EFFECTS OF PROJECT AND CONCLUSION

CHAPTER 5 POSITIVE EFFECTS OF PROJECT AND CONCLUSION

5-1 Positive Effects of the Project

The successful completion of the Project is expected to result in the positive effects listed in Table 5-1.

Table 5-1 Positive Effects of the Project and Degree of Improvement

Current Situation and Problems	Water leakage due to the deterioration of the municipal water supply system and the increased population in Tarawa have resulted in a decreased water supply to the TCH. Coupled with the water supply restrictions, the water supply to the TCH falls short of the demand. This water shortage is serious during the dry season, thus hampering the medical activities of the hospital.
Remedial Measures Envisaged Under the Project	1. Collection of Rainwater from Existing Building Roofs Construction of required facilities: gutters, service pipe network, water storage tanks, pumps, generator, power distribution lines and power distribution board 2. Increased Use of Groundwater from Existing Well Construction of required facilities: water storage tank, power distribution line and power distribution board 3. Extension of Existing Sea water Storage Tank (Relevant Data) 1) Effective rainwater tank capacity (10 tanks): 1,216.8m^3 2) Effective well water tank capacity: 90.0m^3 3) Effective sea water tank capacity: 72.0m^3 4) Total roof area for rainwater collection: 5,407.04m^2
Positive Effects of the Project	1. The required water supply volume will be secured through the appropriate mixed use of municipal water, rainwater, well water and sea water. 2. The dependence on the municipal water supply will be reduced by 30%, solving the problem of an inadequate service water supply. 3. The efficient use of the new water tanks will shorten the water shortage period in dry years. 1) Total supply of service water: 100m^3/working day (present supply of 75m^3, short by 25m^3/day) - Rainwater: 25m^3/working day (present: less than 1m^3/day) - Well water: 50m^3/working day (present: less than 40m^3/day) - Municipal water: 25m^3/working day (present: less than 35m^3/day) 2) Supply of sea water: 40m^3/working day (present: less than 20m^3/day) 3) The water shortage period in a dry year (annual rainfall: less than 1,000mm) can be reduced to a maximum of 3-4 months. 4) The surplus water can be distributed to the neighbourhood by tankers.

5-2 Suitability of the Project

(1) Operation and Maintenance

No staff recruitment is necessary as the technical level set by the Project is designed to permit the operation and maintenance of the new facilities by the current staff.

(2) Budgetary Appropriation

The additional cost of the operation and maintenance of the new facilities only amounts to approximately 0.1% of the fiscal 1992 budget of the Ministry of Health and Family Planning for the first and second years after the completion of the Project and approximately 0.2% for the third year onwards. There is little likelihood, therefore, that the budget of the Ministry of Health will be hard pressed by the cost of running the new facilities.

(3) Conclusion

The Project is feasible and does not present any special difficulties. As often described earlier, the successful completion of the Project will greatly contribute to the smooth operation of the TCH, the only general hospital in Kiribati, and will at least guarantee the public medical care and health services of the minimum quality. In view of these positive effects, the execution of the Project with Japanese grant aid is deemed appropriate.

(4) Recommendations

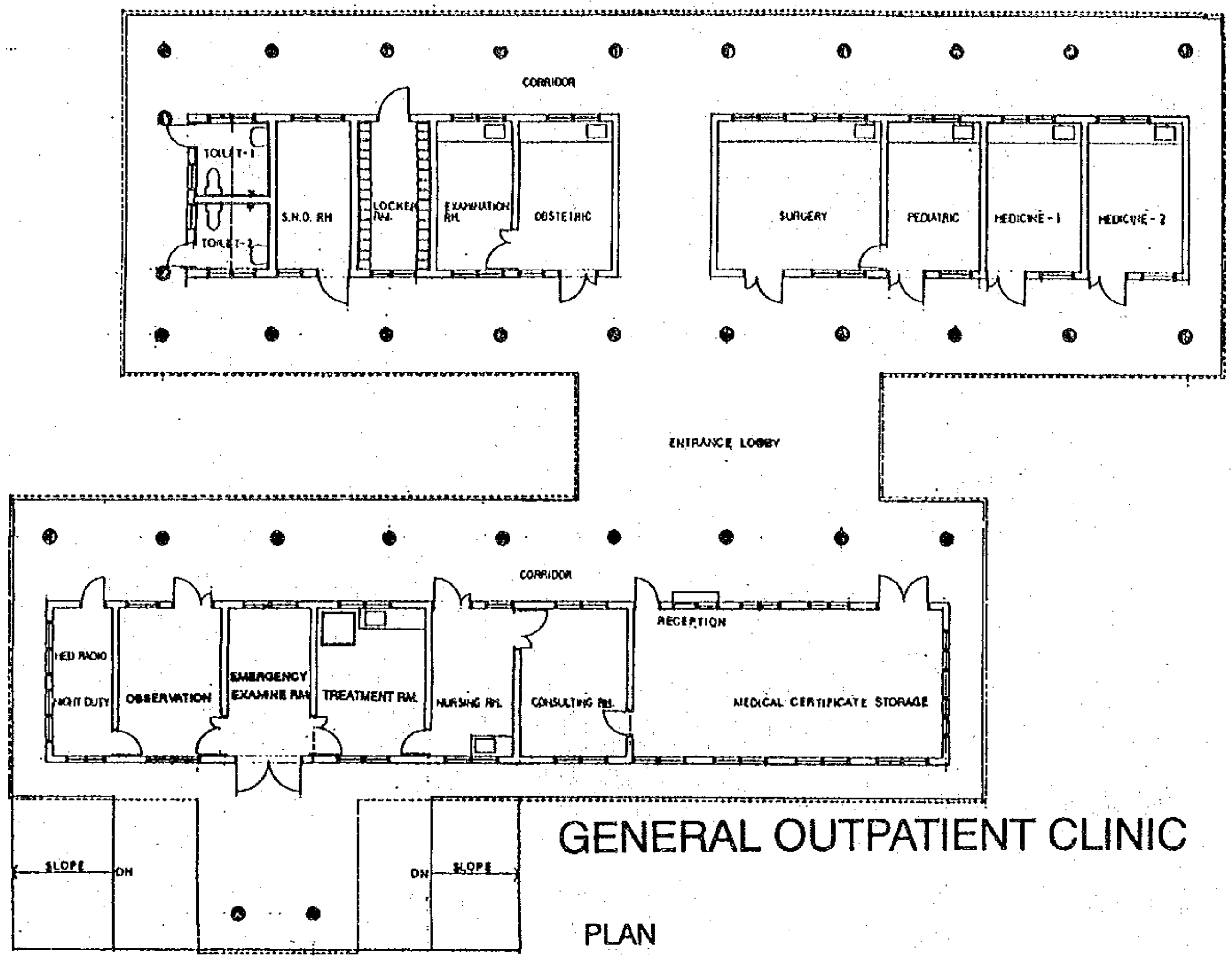
From the long-term perspective, the preparation of a large-scale water supply plan, of which the present Project may constitute a part, is desirable in view of the characteristics of the local climate in that there is a possibility of successive dry years. While the accurate forecasting of natural phenomena is difficult, further expansion of the water supply should be continuously sought to adequately deal with the ever increasing demand for service water. It must be noted that the development of a salt-to-fresh water distillation system capable of using such natural energies as solar energy and sea wave energy is of great importance for all island countries, of which Kiribati is one, suffering from a chronic water shortage.

Reference

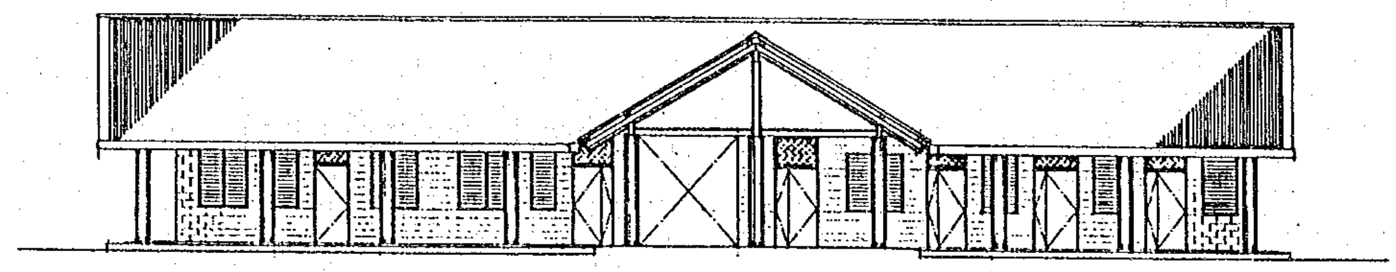
EXISTING TCH ARCHITECTURE DESIGN DRAWINGS

1. SPECIALITY OUTPATIENT CLINIC
   GENERAL OUTPATIENT CLINIC
2. DENTAL OUTPATIENT CLINIC
   (UNDER CONSTRUCTION WITH FRENCH ASSISTANCE)
3. PHARMACY
4. OPERATION THEATRE
5. X-RAY DEPARTMENT
6. LABORATORY & BLOOD BANK
7. PRIVATE WARD
8. MEDICAL WARD
9. PEDIATRIC WARD
10. SURGICAL WARD
11. OBSTETRIC WARD
12. TUBERCULOSIS WARD
13. ADMINISTRATION BUILDING
14. HEALTH EDUCATION
15. KITCHEN, CAFETERIA
16. LAUNDRY, WORK SHOP
17. ELEVATED WATER, TANK DRYING YARD
18. NURSING SCHOOL
19. STUDENT DORMITORY
20. STUDENT DORMITORY
21. MORTUARY, GENERATOR HUT
22. MANEABA, FUEL STORAGE
23. TOILET TYPE-1
    TOILET TYPE-2

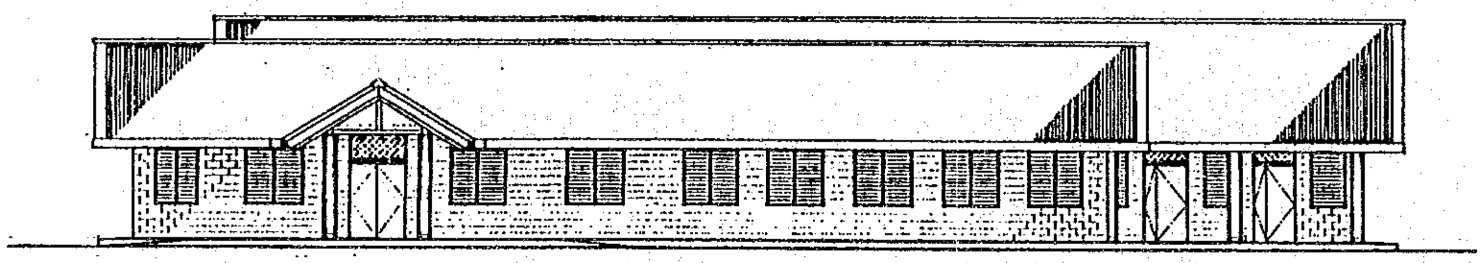
SPECIALITY OUTPATIENT CLINIC



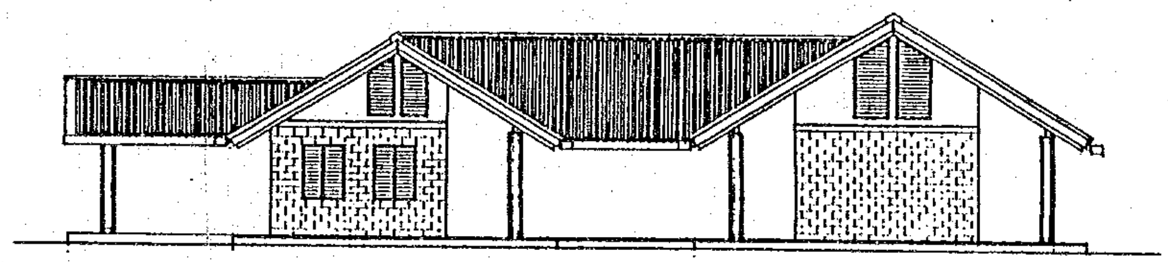
PLAN



SECTION



EAST ELEVATION



NORTH ELEVATION

SPECIALITY OUTPATIENT CLINIC
GENERAL OUTPATIENT CLINIC

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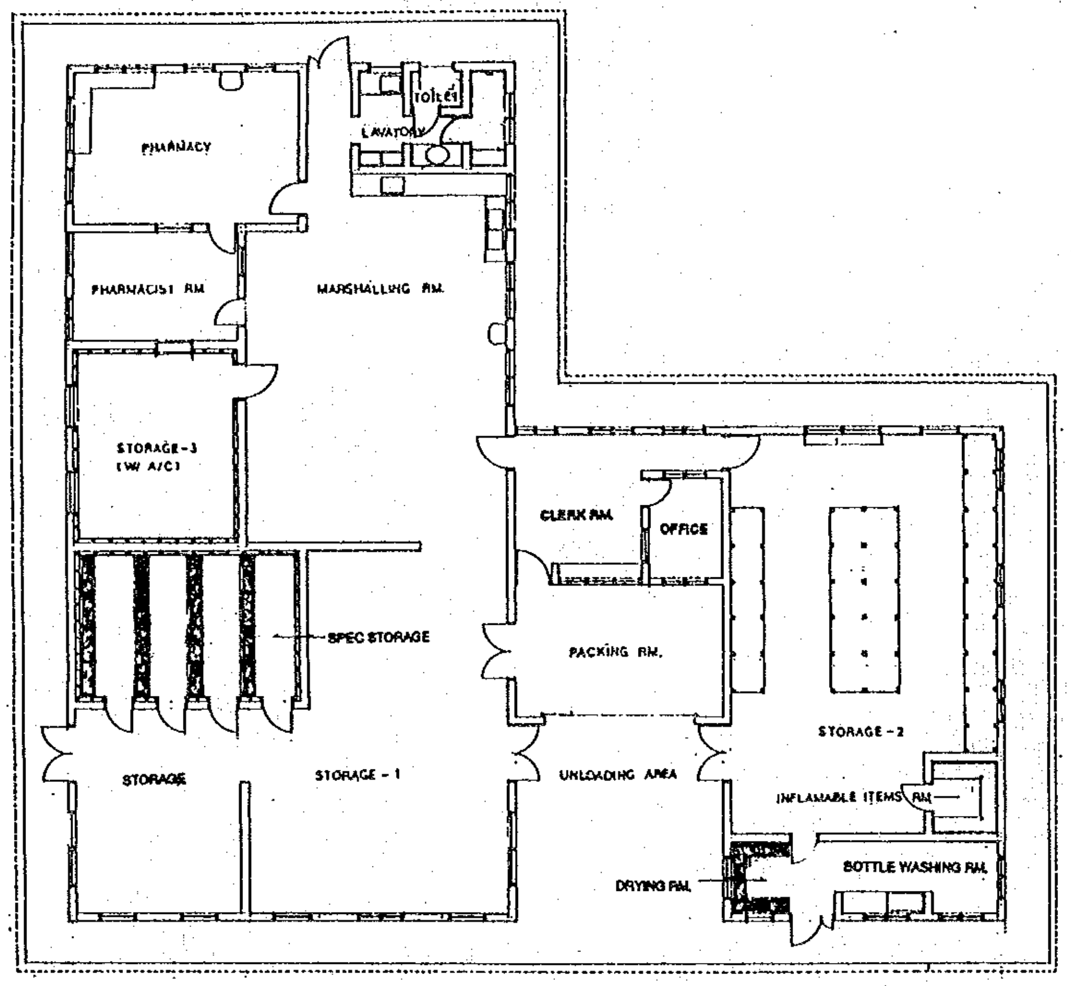
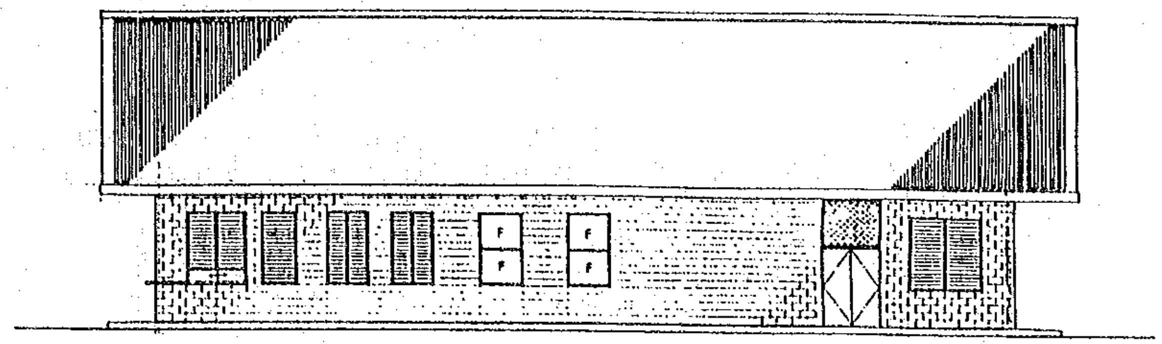
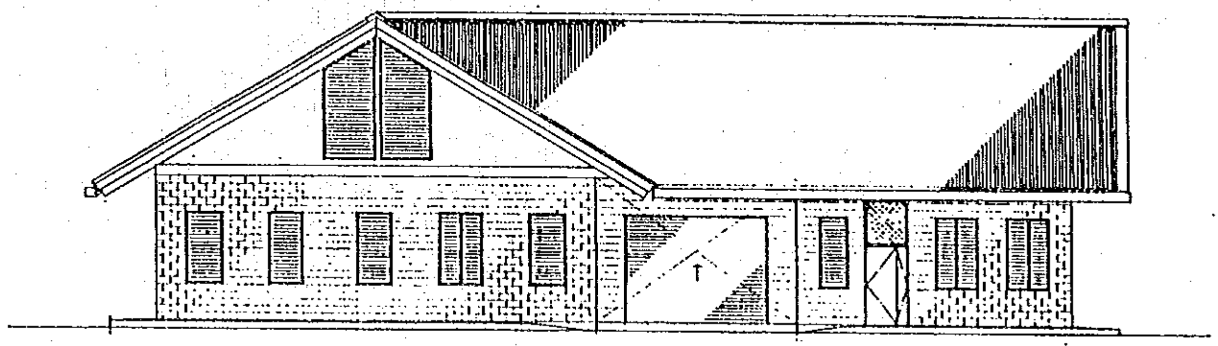


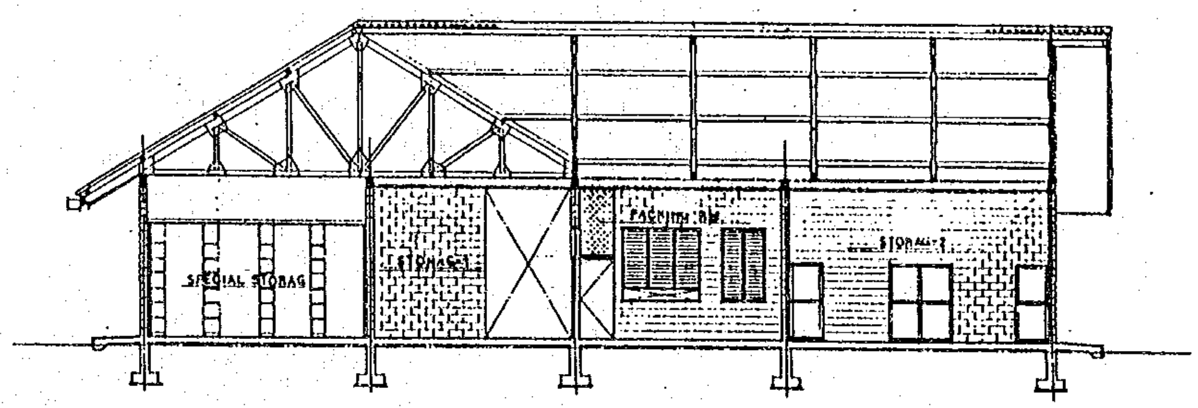
PLAN



WEST ELEVATION



NORTH ELEVATION



SECTION

PHARMACY

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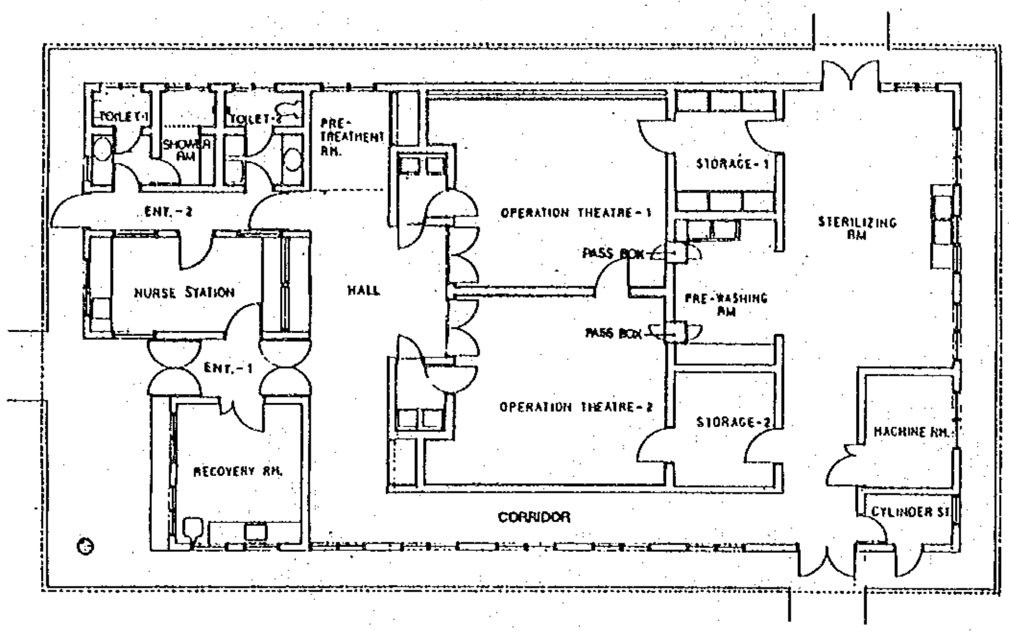

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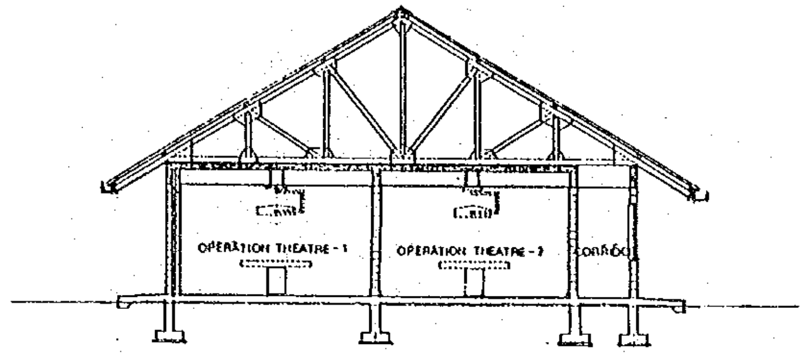

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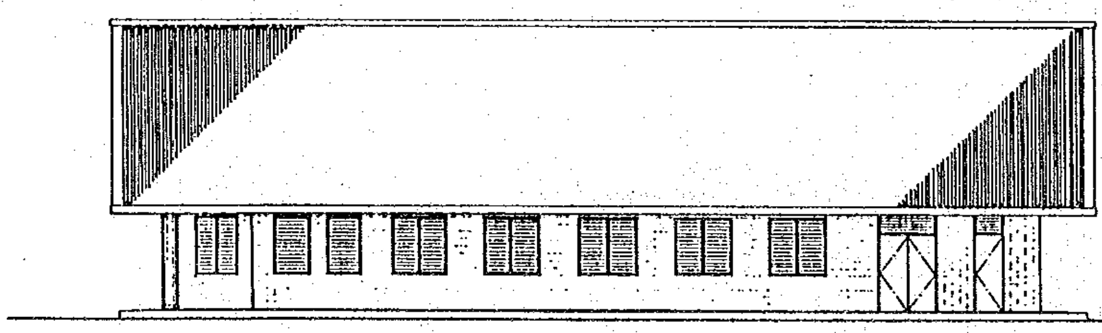
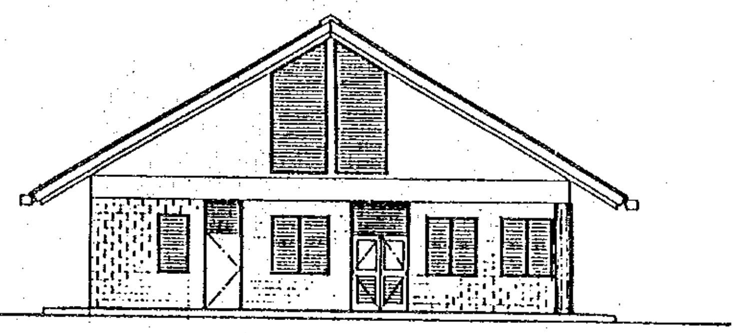
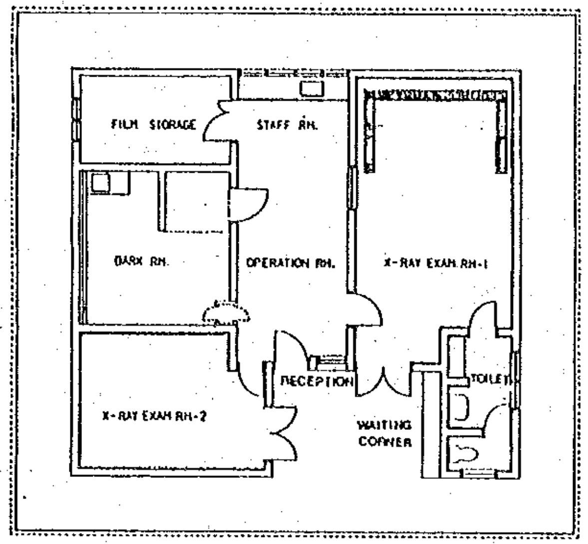


NORTH ELEVATION

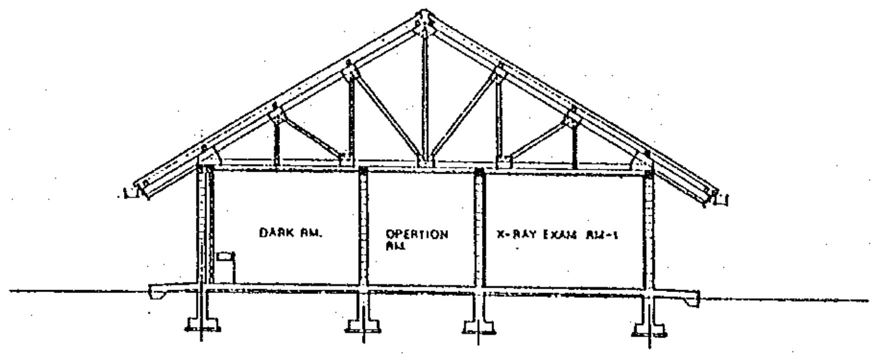


EAST ELEVATION

OPERATION THEATRE



PLAN



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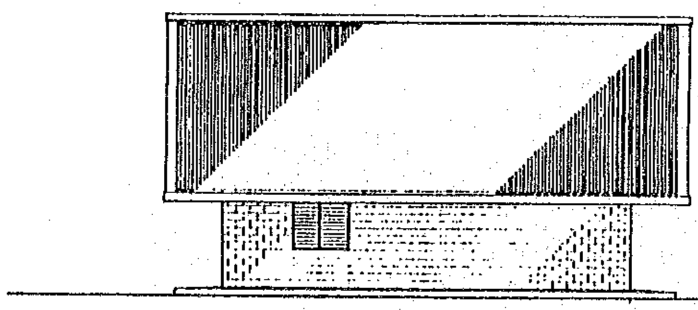
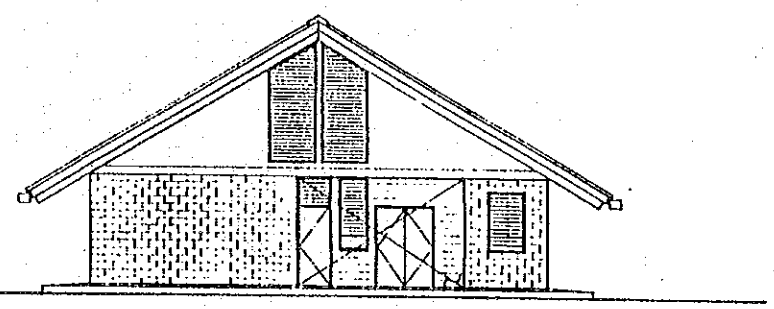


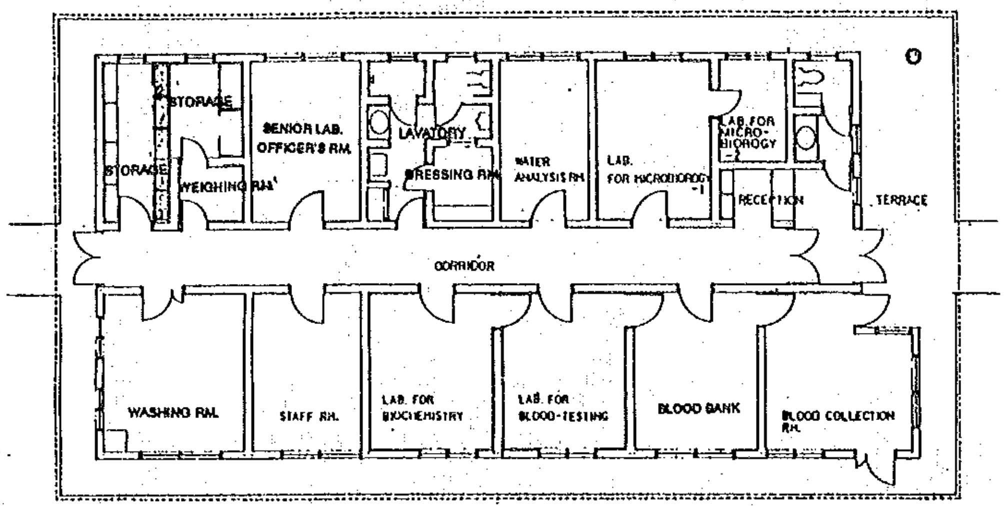
WEST ELEVATION



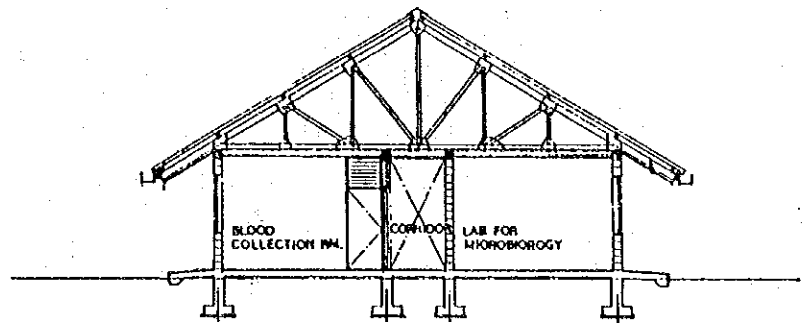
NORTH ELEVATION

X-RAY DEPARTMENT

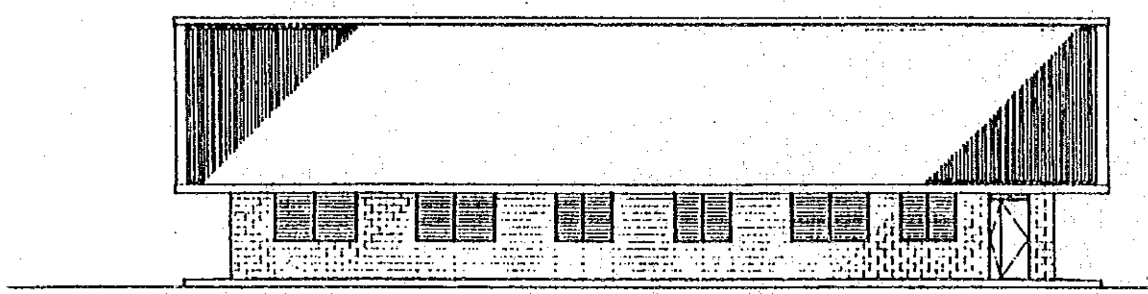
SCALE 1 : 200 0 1 3 5 10M



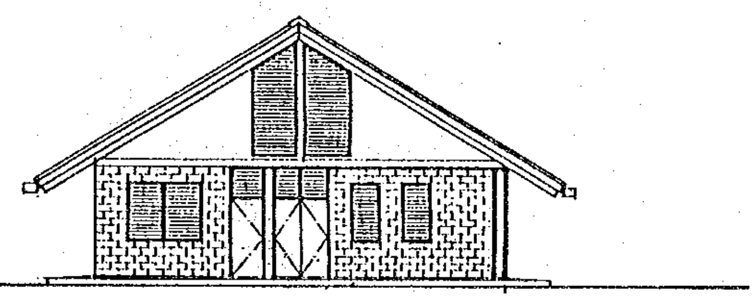
PLAN



SECTION



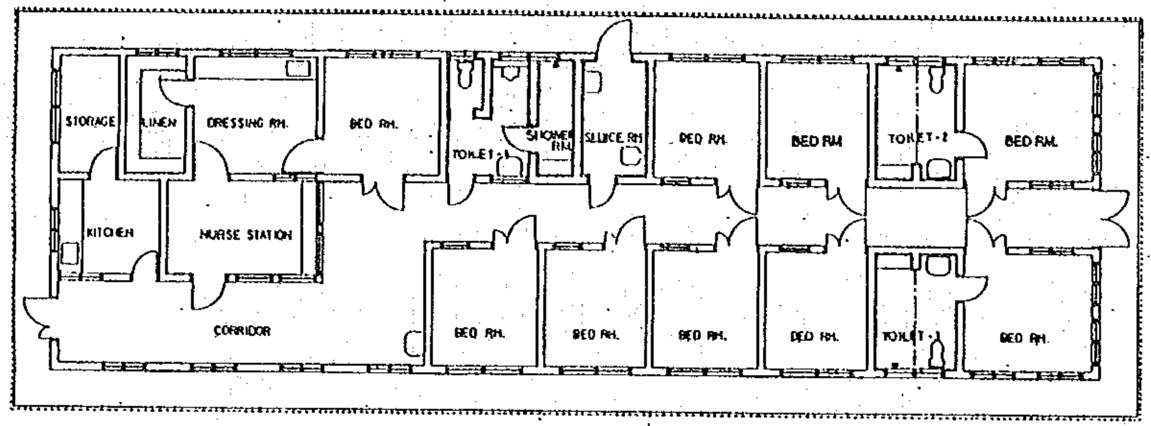
NORTH ELEVATION



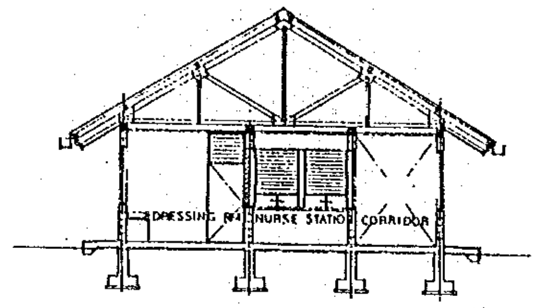
EAST ELEVATION

LABORATORY & BLOOD BANK

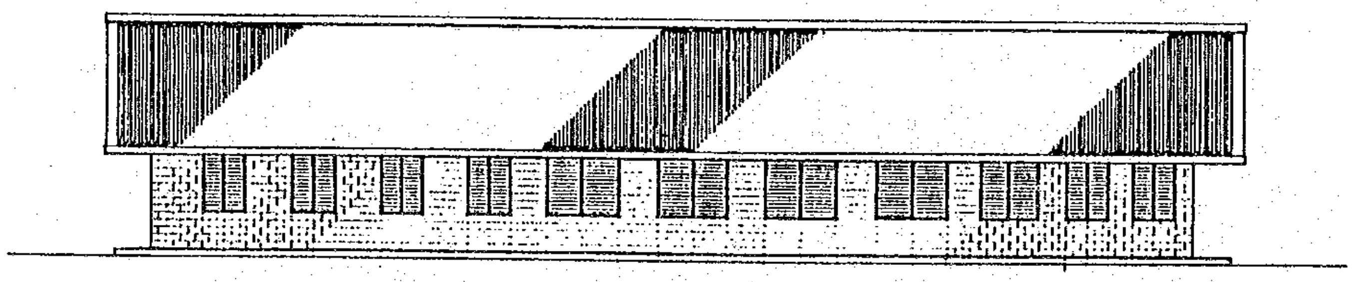
SCALE 1:200 0 1 3 5 10M



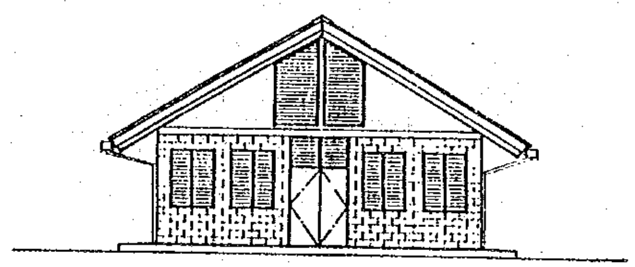
PLAN



SECTION



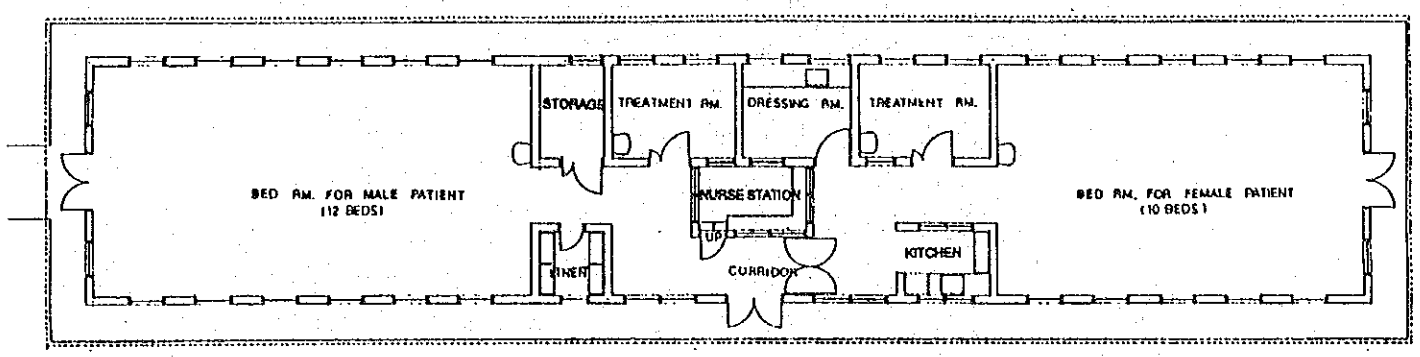
WEST ELEVATION



SOUTH ELEVATION

PRIVATE WARD

SCALE 1:200 0 1 3 5 10M



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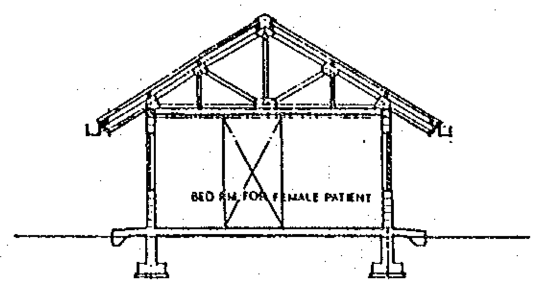

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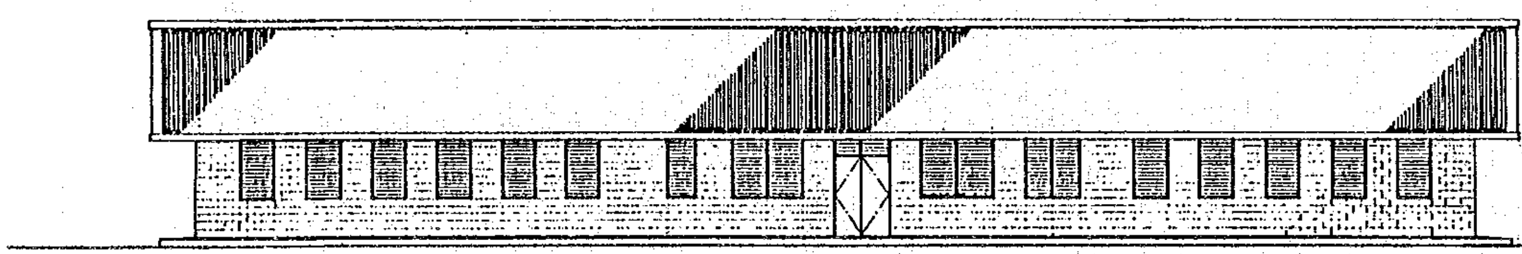
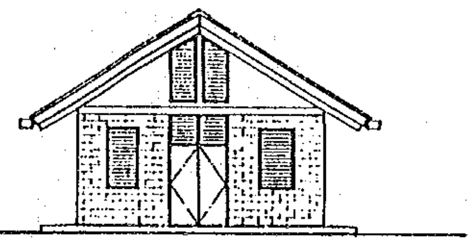


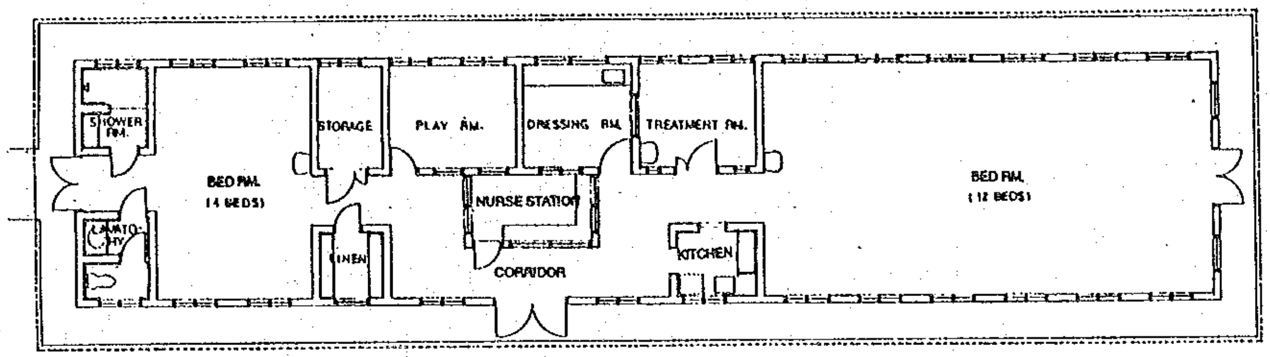
WEST ELEVATION



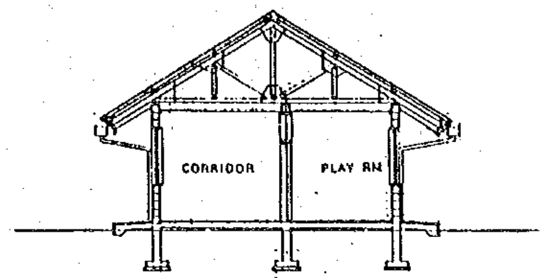
NORTH ELEVATION

MEDICAL WARD

SCALE 1:200 0 1 3 5 10 M



PLAN



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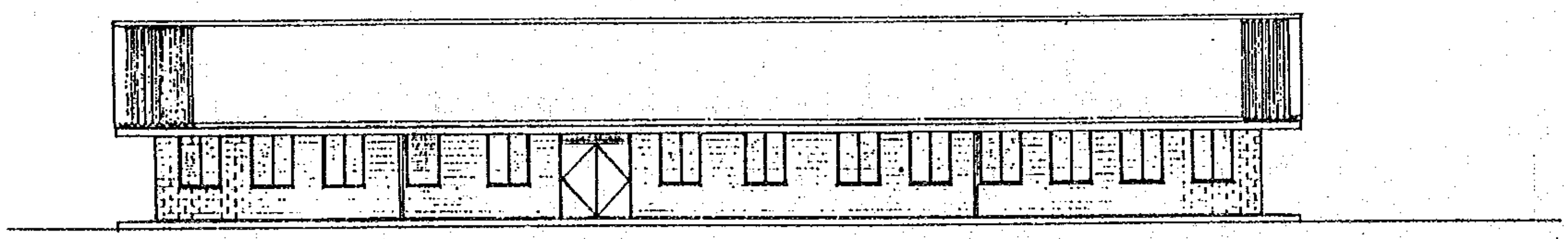
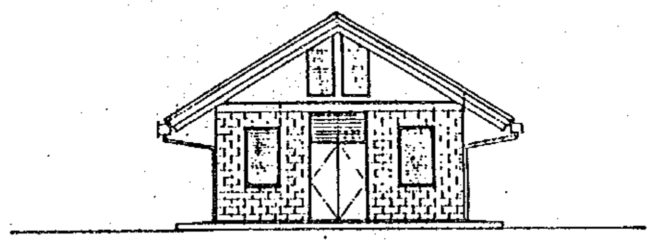


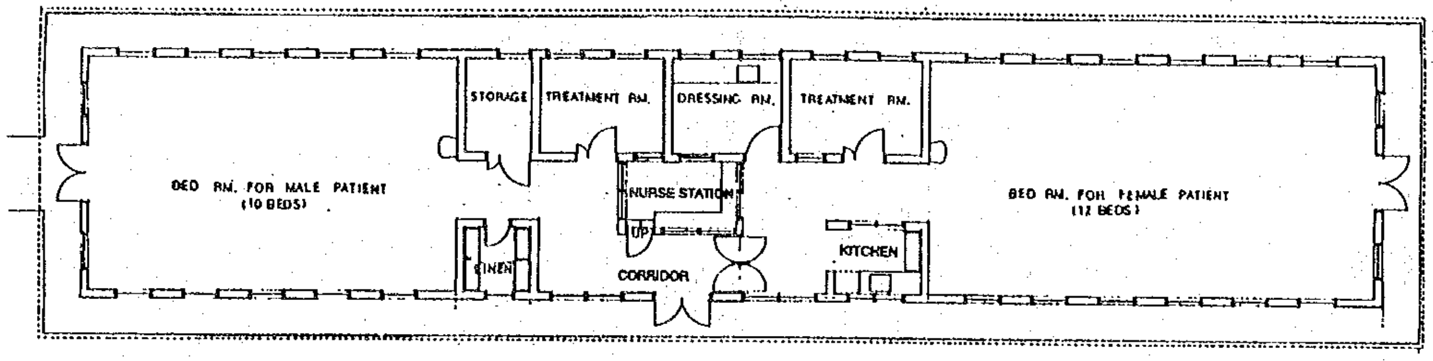
WEST ELEVATION



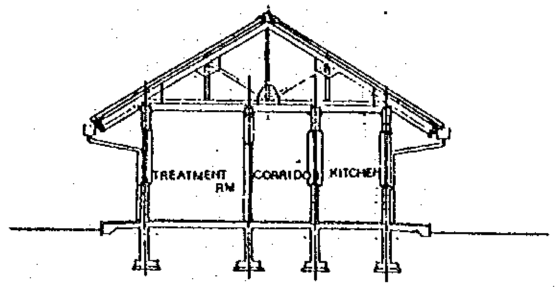
SOUTH ELEVATION

PEDIATRIC WARD

SCALE 1:200 0 1 3 5 10M



PLAN



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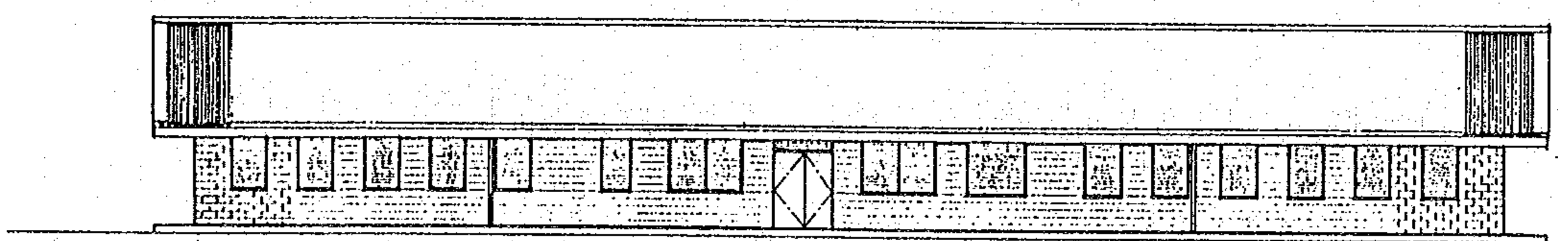
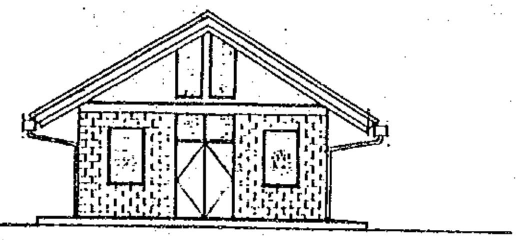


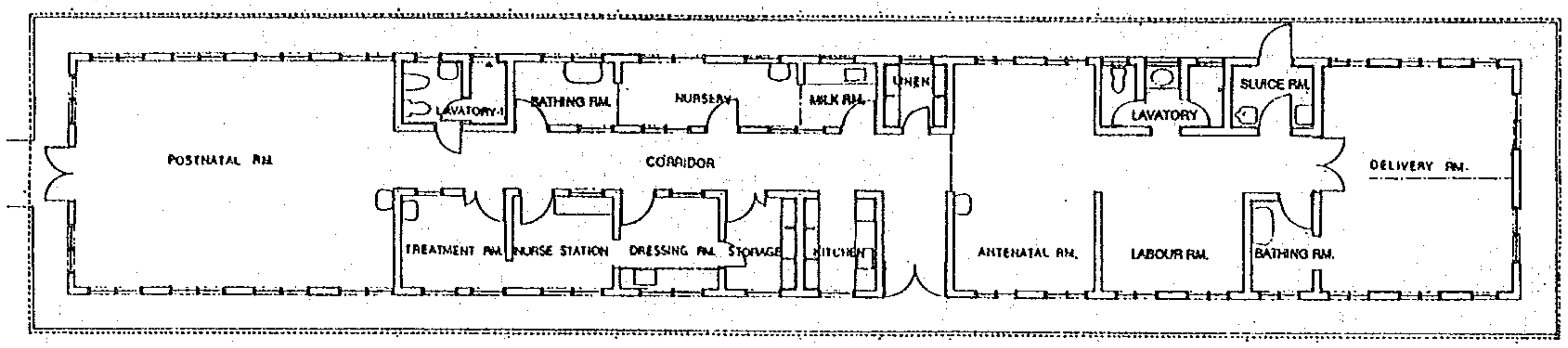
WEST ELEVATION



SOUTH ELEVATION

SURGICAL WARD

SCALE 1:200 0 1 3 5 10M



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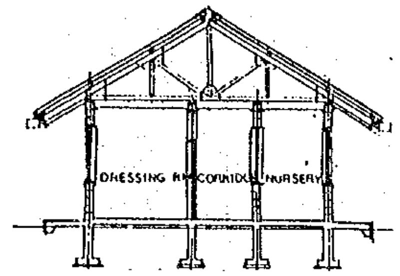

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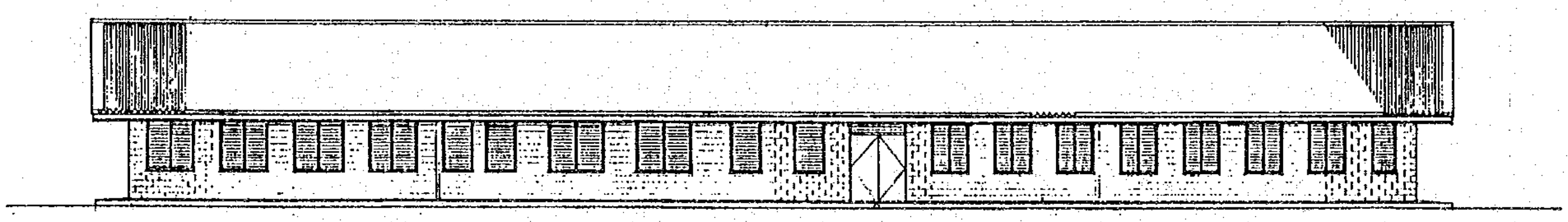
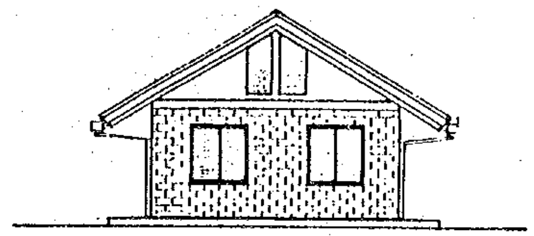


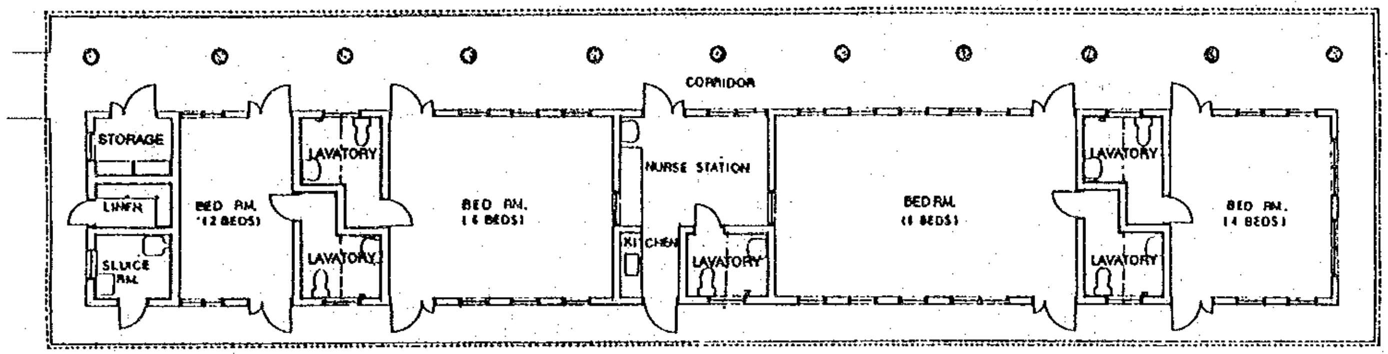
WEST ELEVATION



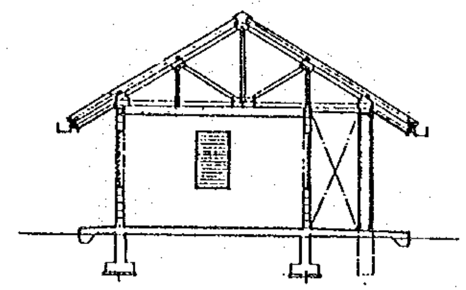
SOUTH ELEVATION

OBSTETRIC WARD

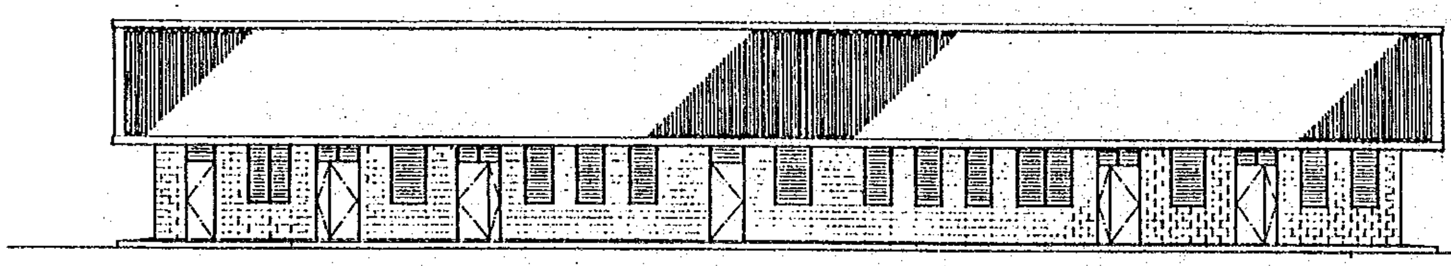
SCALE 1:200 0 1 3 5 10M



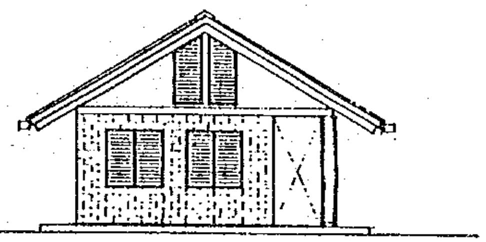
PLAN



SECTION



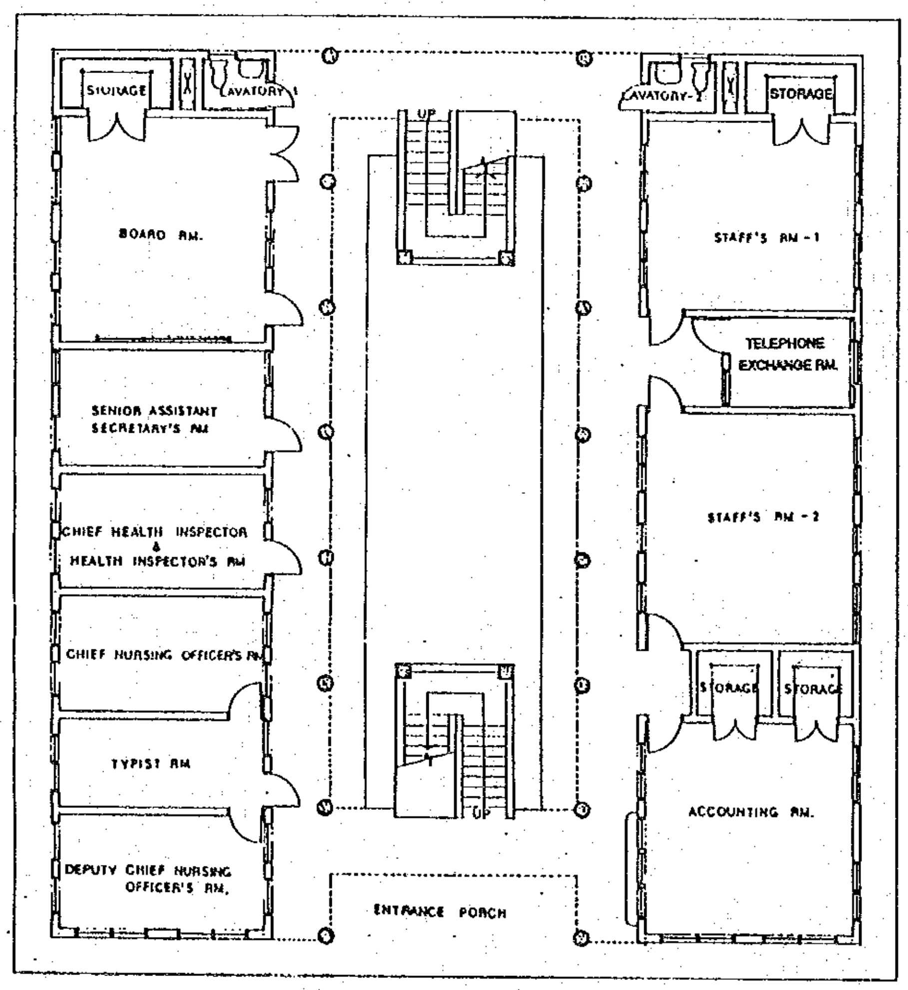
WEST ELEVATION



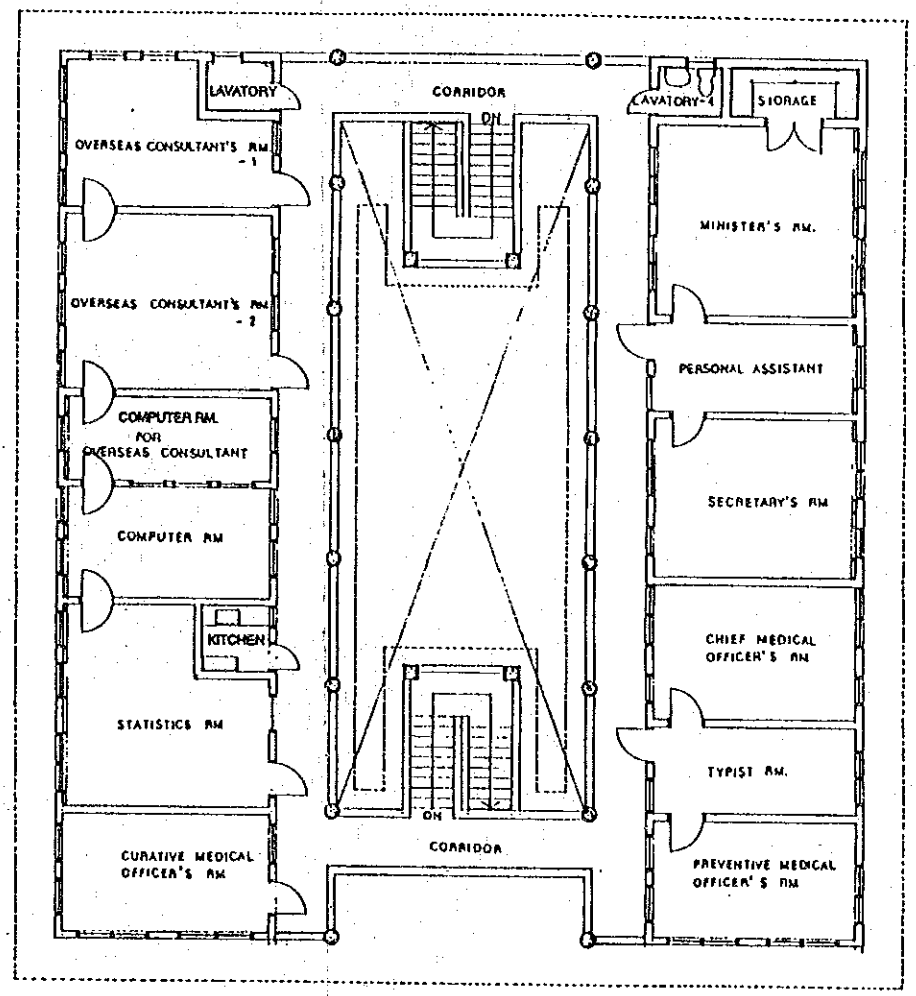
SOUTH ELEVATION

TUBERCULOSIS WARD

SCALE 1:200 0 1 3 5 10M



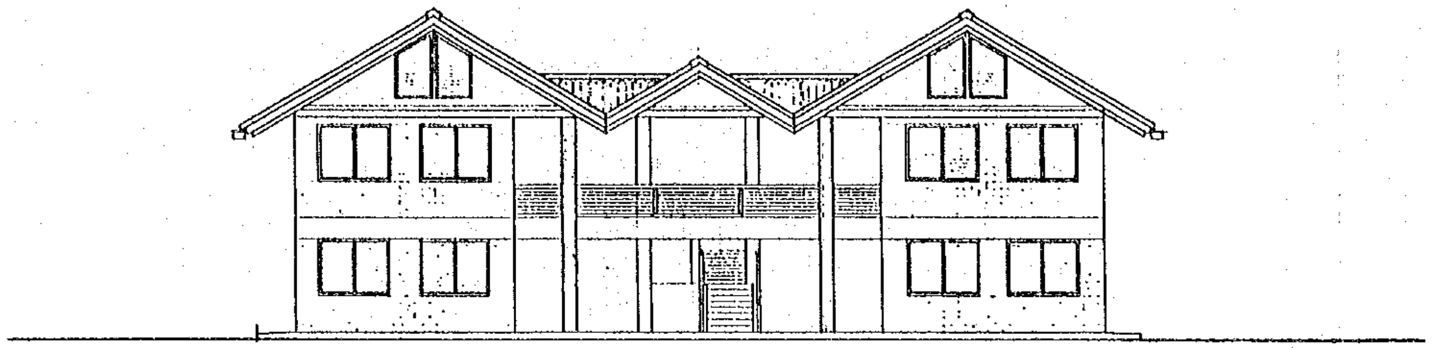
1st FLOOR PLAN



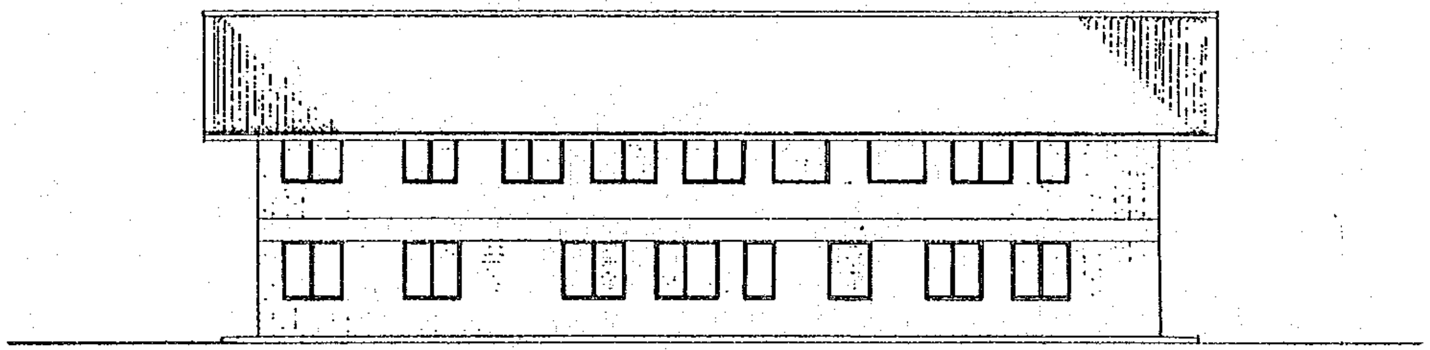
2nd FLOOR PLAN

ADMINISTRATION BUILDING

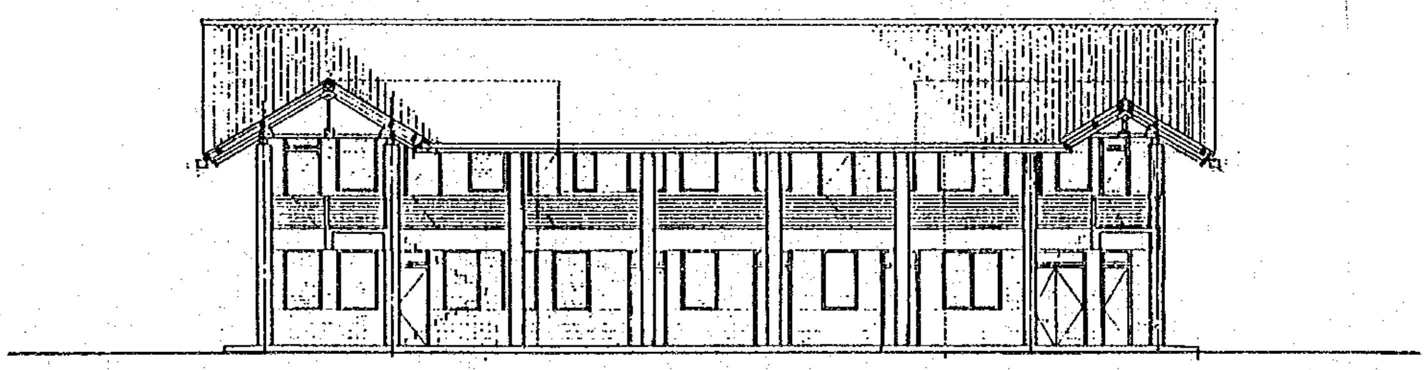
SCALE 1:200 0 1 3 5 10M



NORTH ELEVATION



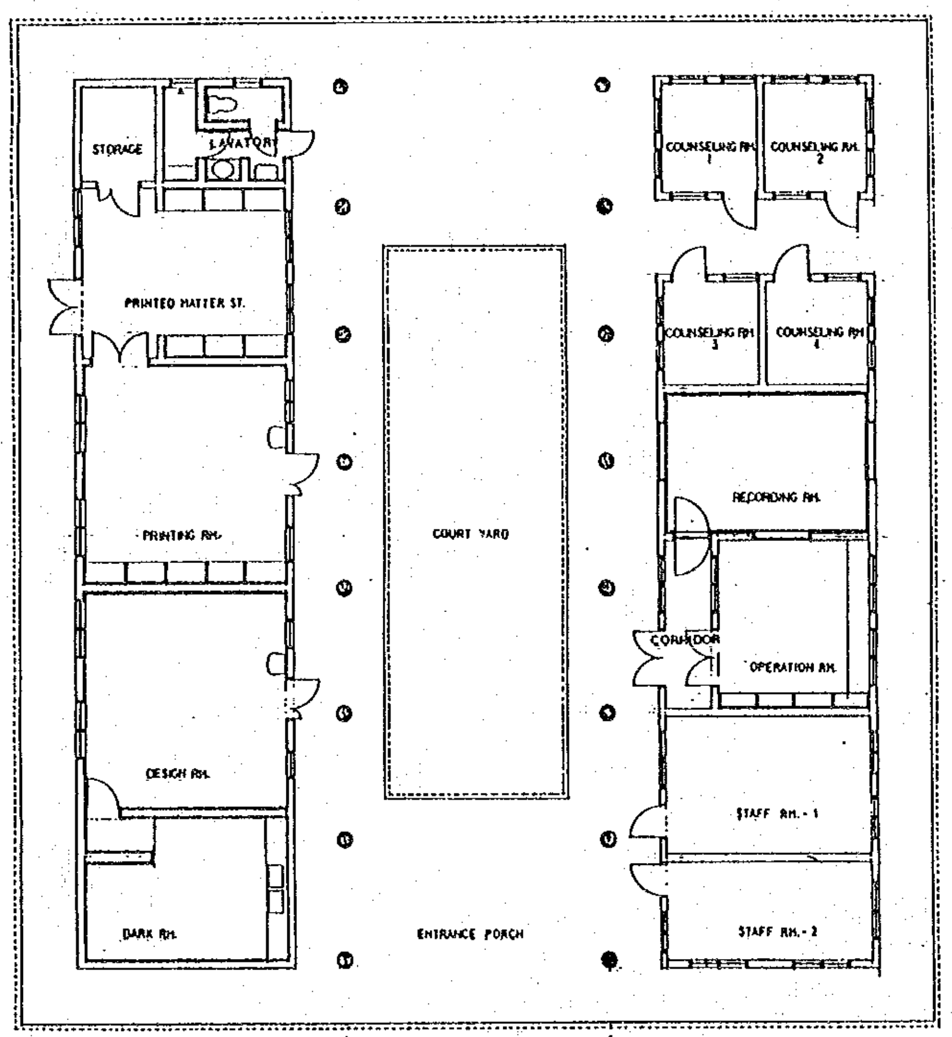
WEST ELEVATION



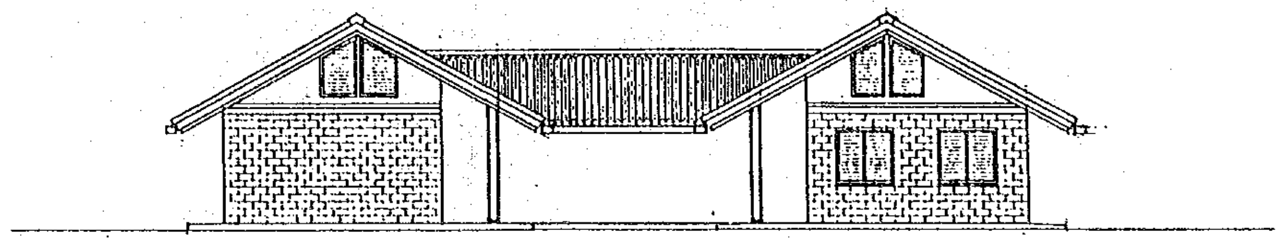
SECTION

ADMINISTRATION BUILDING

SCALE 1:200 0 1 3 5 10M



PLAN



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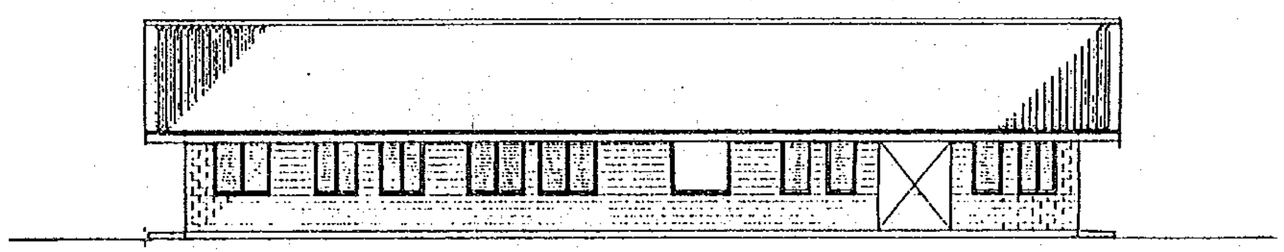

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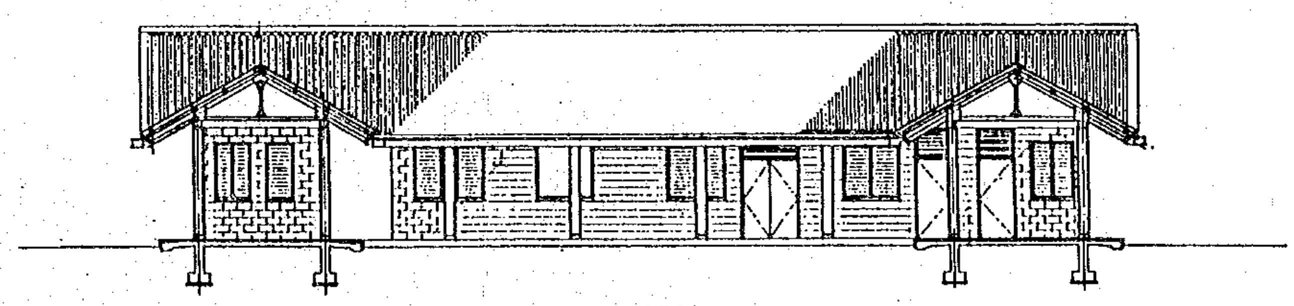
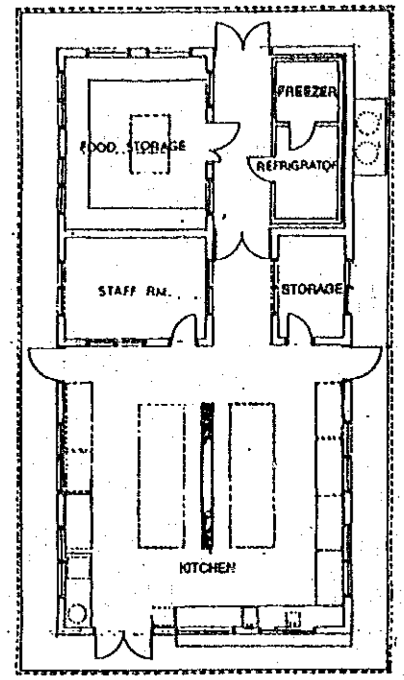


SECTION

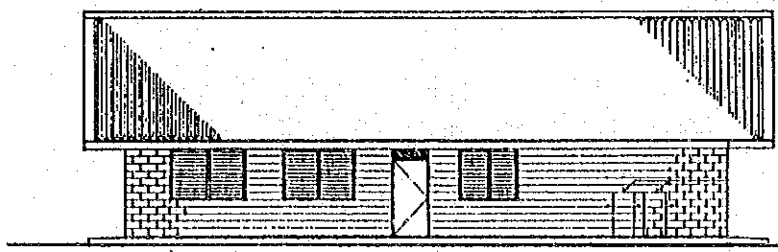
HEALTH EDUCATION

SCALE 1:200 0 1 3 5 10M

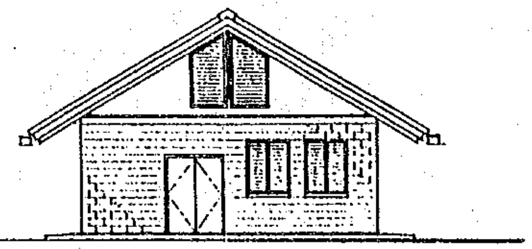
KITCHEN



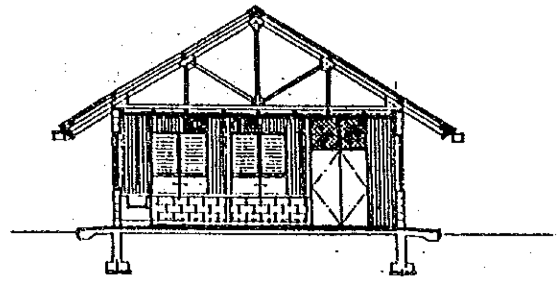
PLAN



EAST ELEVATION

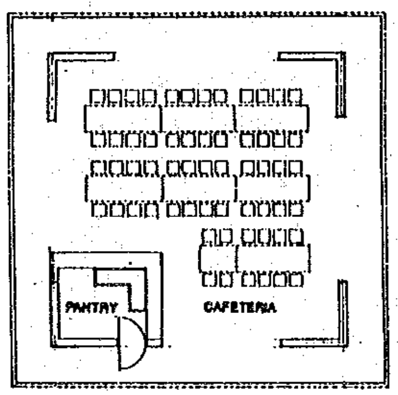


NORTH ELEVATION

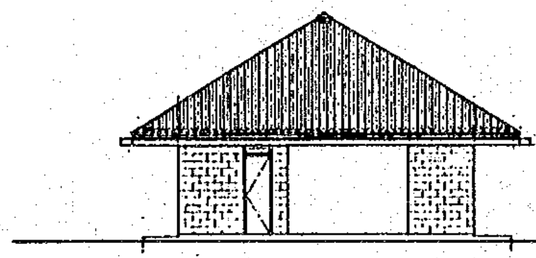


SECTION

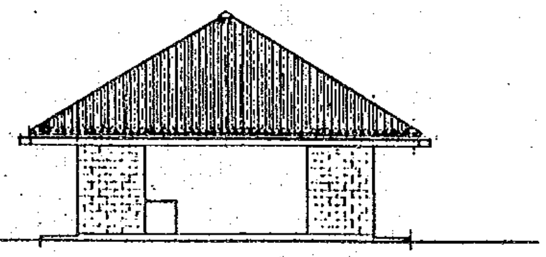
CAFETERIA



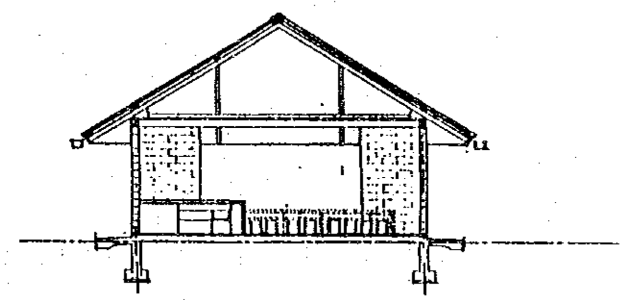
PLAN



EAST ELEVATION



NORTH ELEVATION

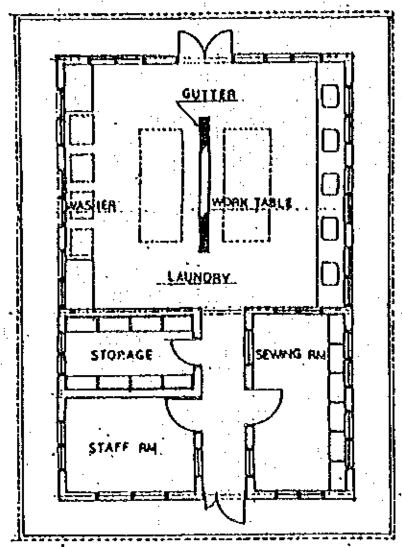


SECTION

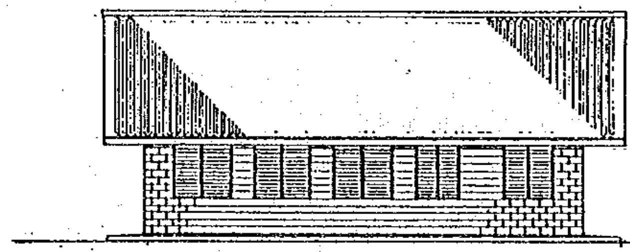
KITCHEN
CAFETERIA

SCALE. 1:200 0 1 3 5 10M

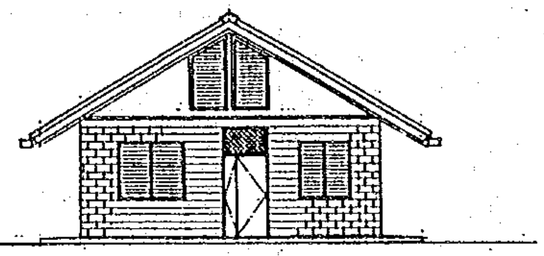
LAUNDRY



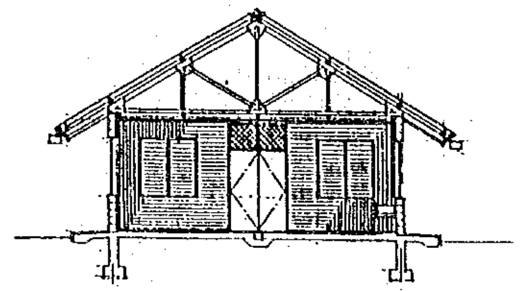
PLAN



WEST ELEVATION

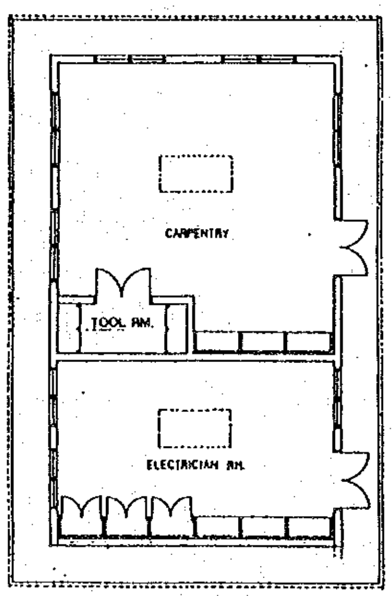


SOUTH ELEVATION

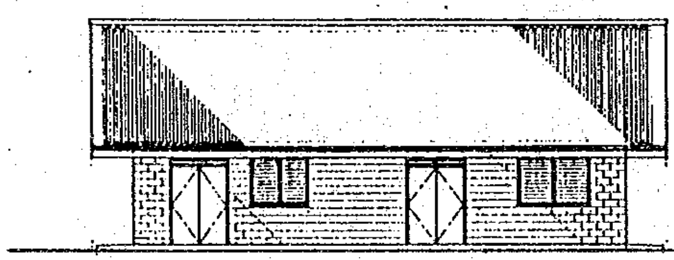


SECTION

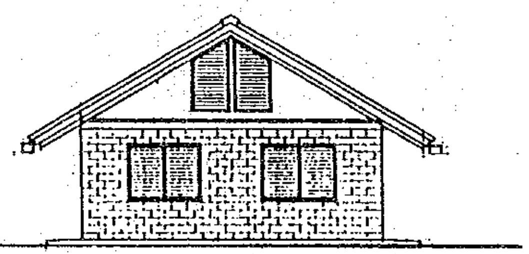
WORK SHOP



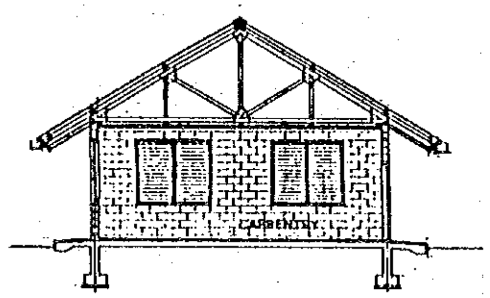
PLAN



EAST ELEVATION



NORTH ELEVATION

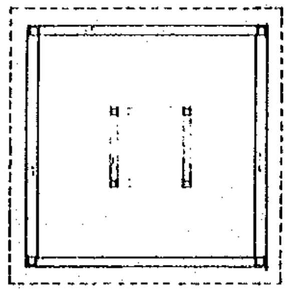


SECTION

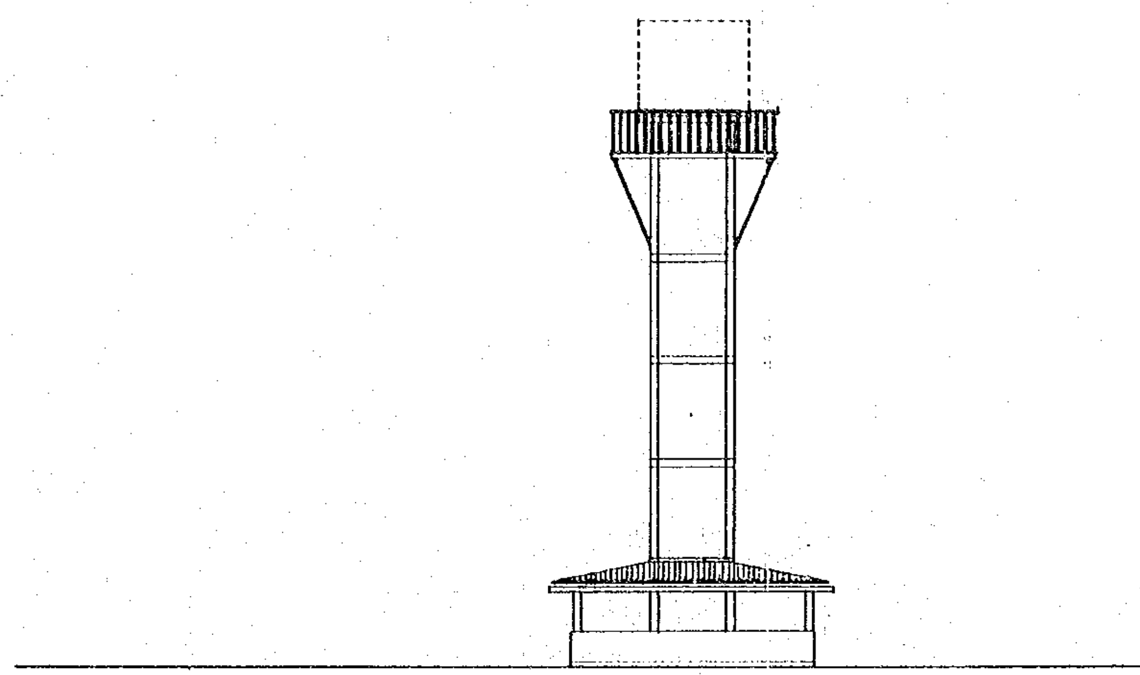
LAUNDRY
WORK SHOP

SCALE 1 : 200 0 1 3 5 10M

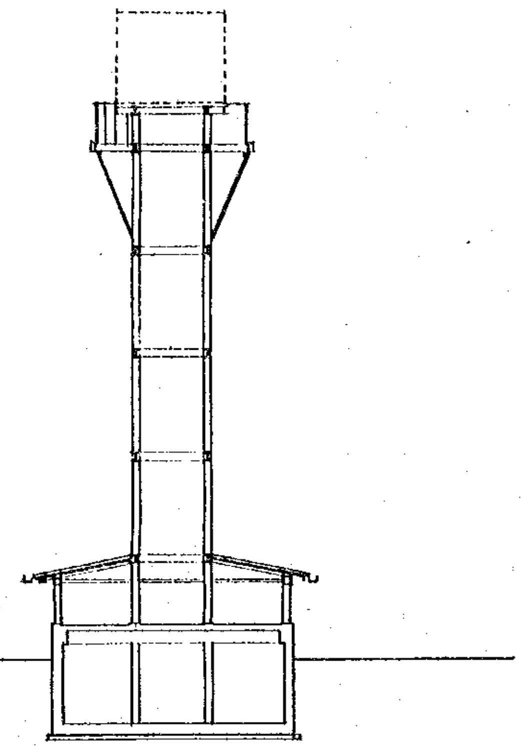
ELEVATED WATER TANK



PLAN

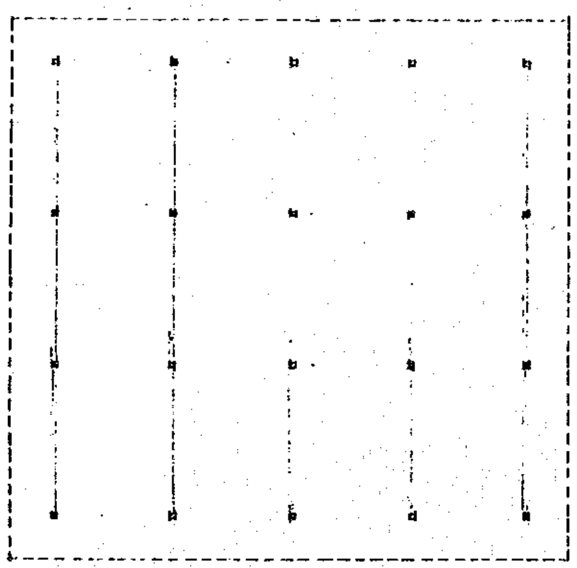


EAST ELEVATION



SECTION

DRYING YARD



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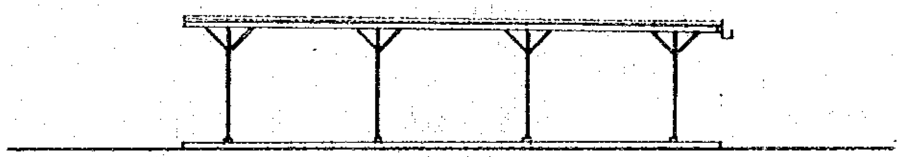
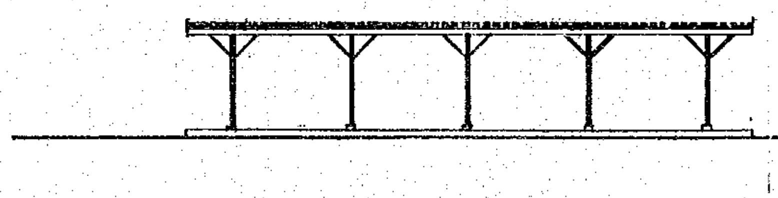
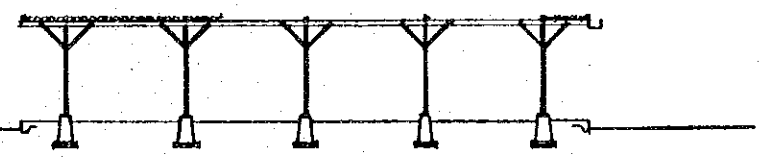


SOUTH ELEVATION



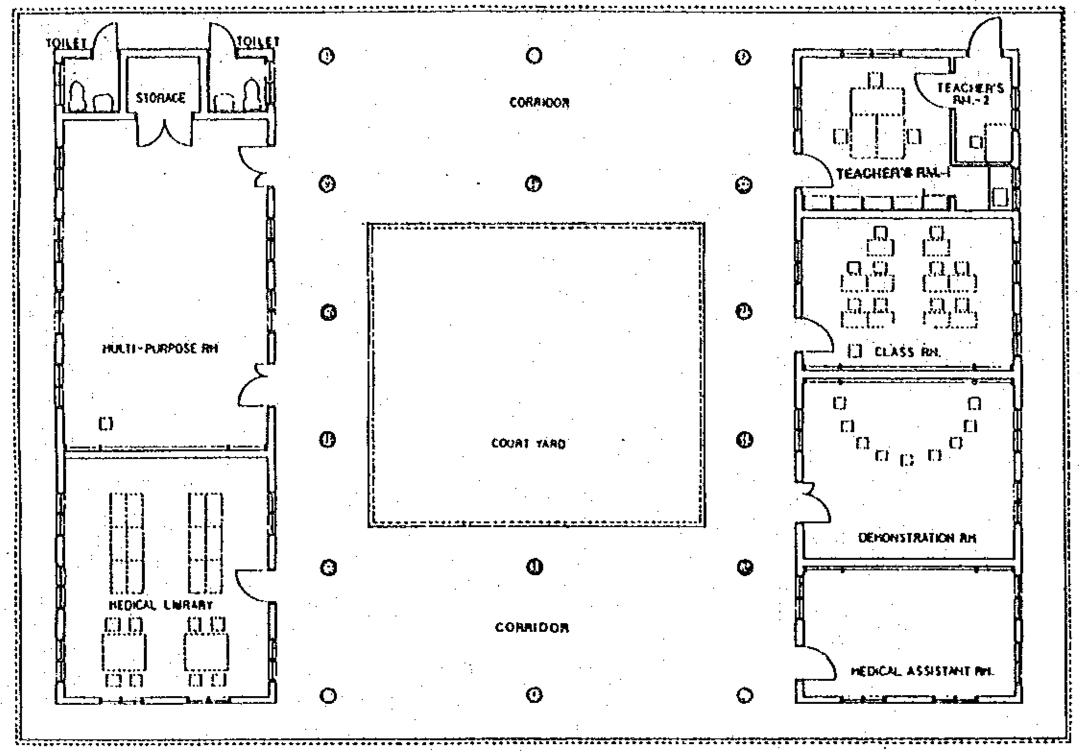
EAST ELEVATION



SECTION

ELEVATED WATER TANK
DRYING YARD

SCALE 1:200 0 1 3 5 10M



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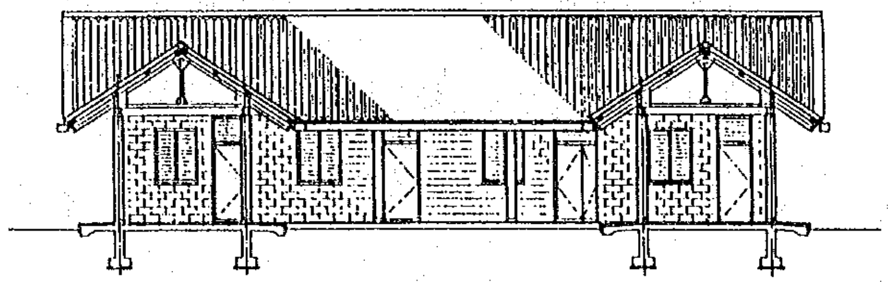
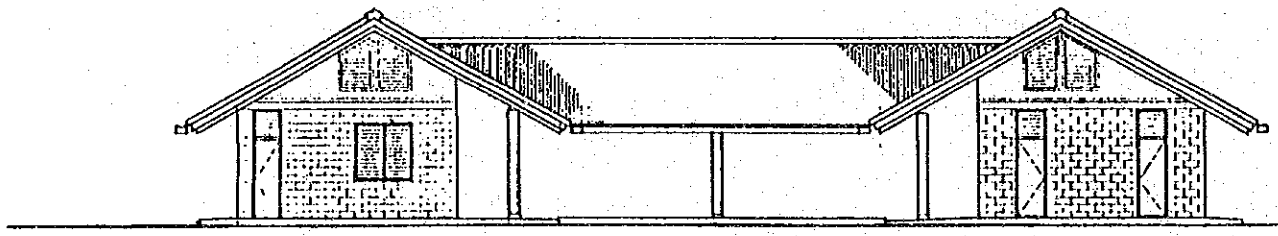
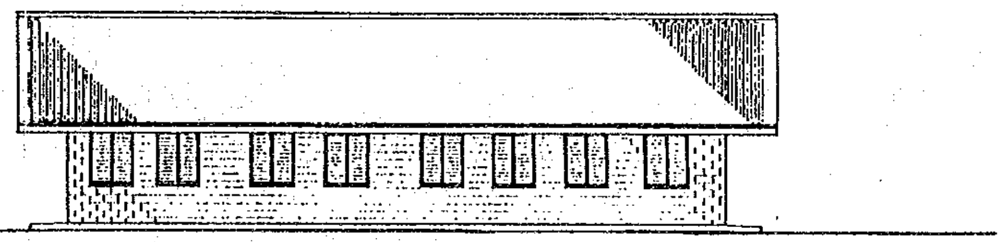


SECTION



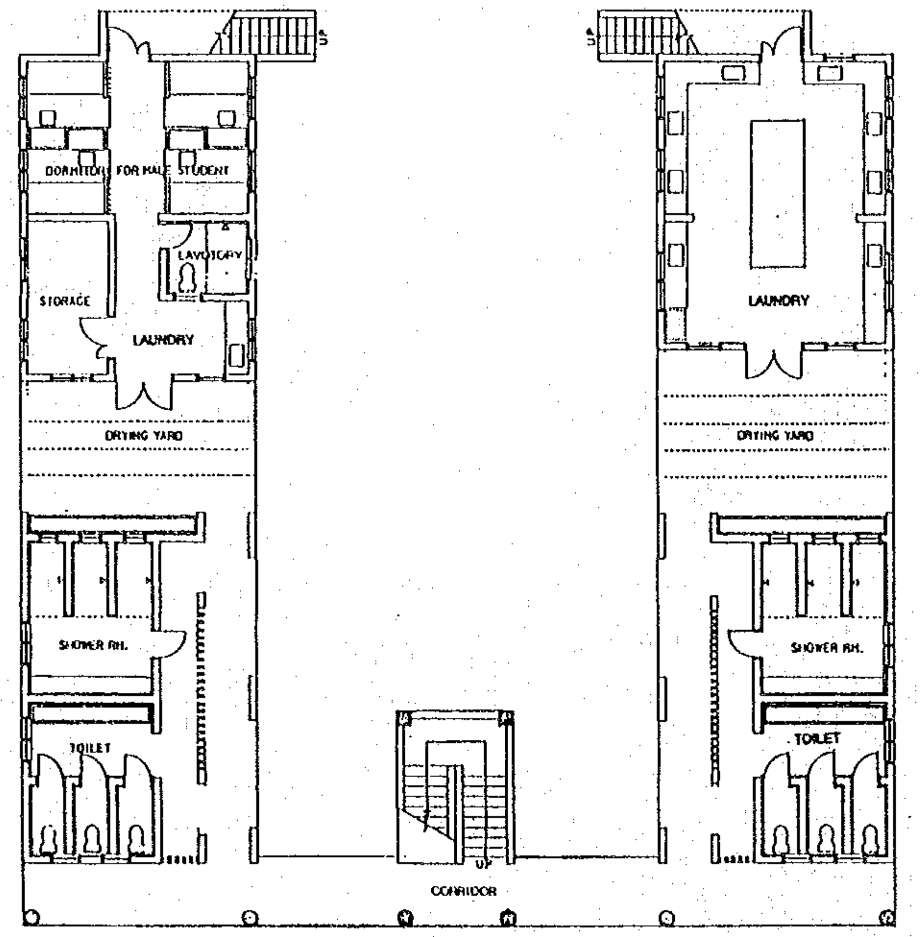
SOUTH ELEVATION



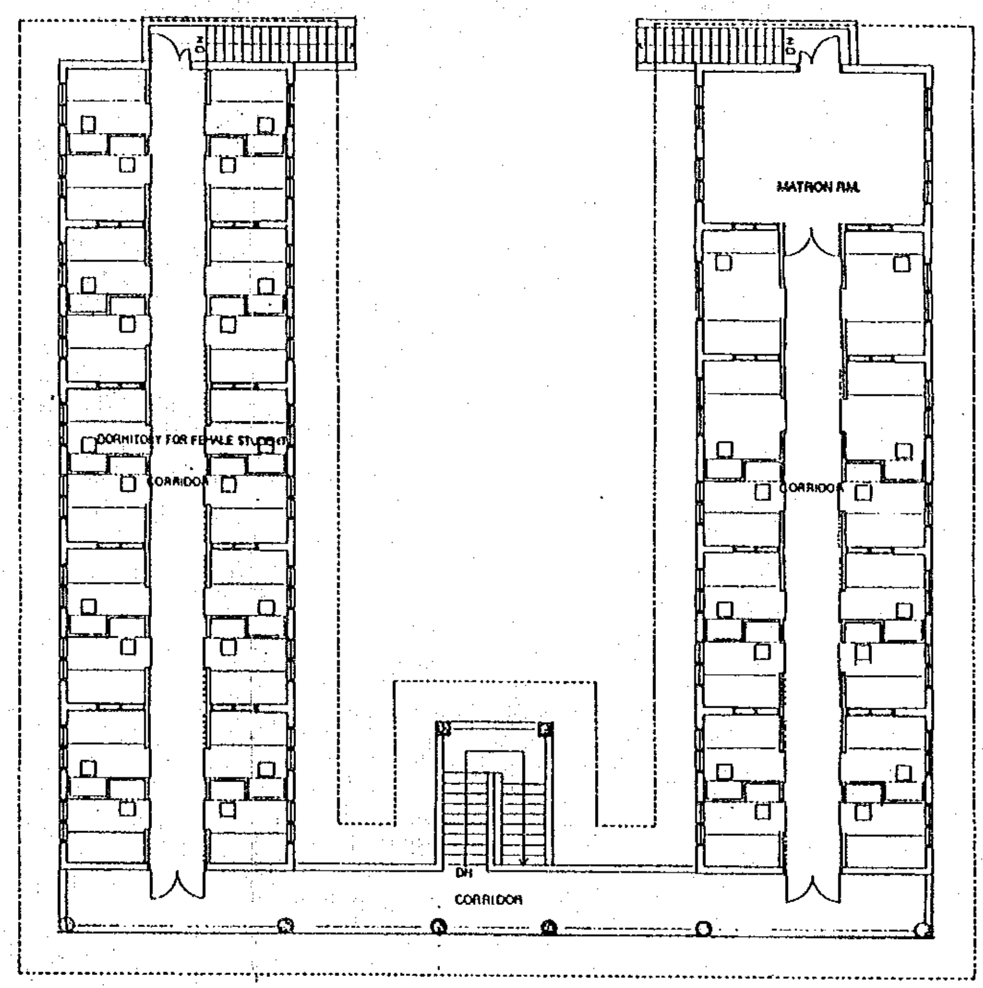
WEST ELEVATION

NURSING SCHOOL

SCALE 1:200 0 1 3 5 10M



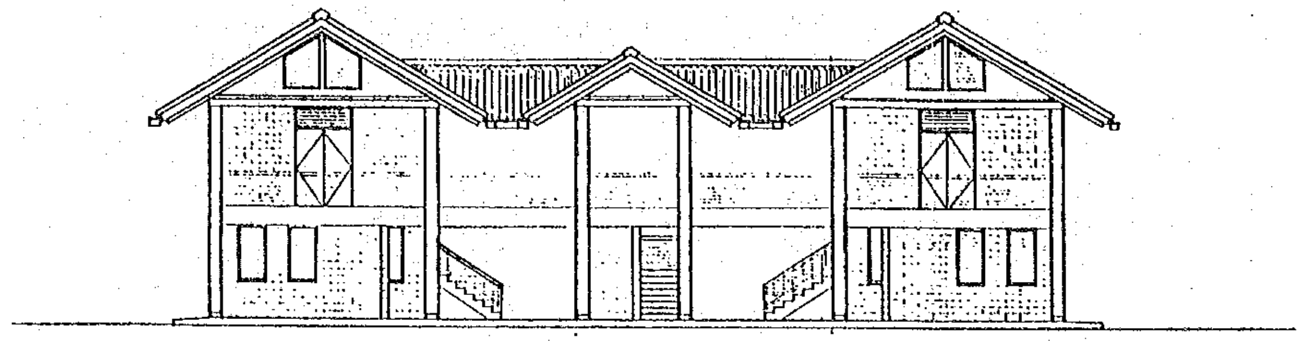
1st FLOOR PLAN



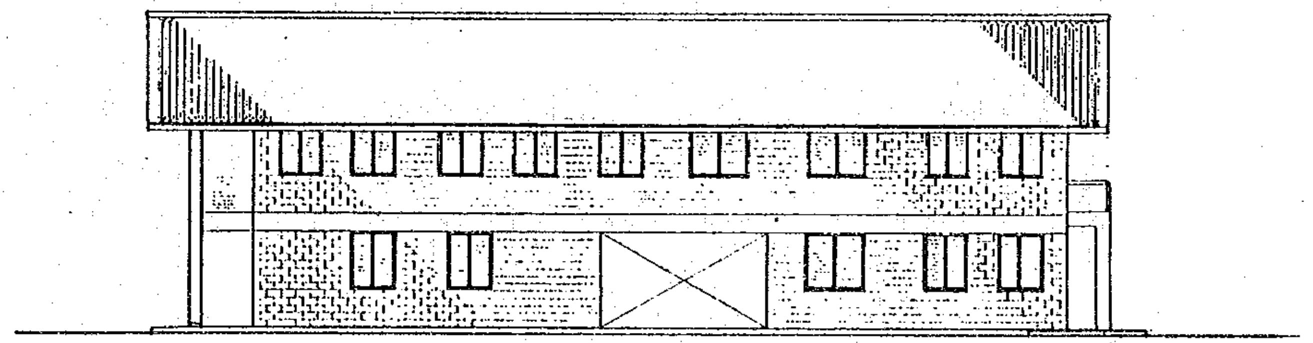
2nd FLOOR PLAN

STUDENT DORMITORY

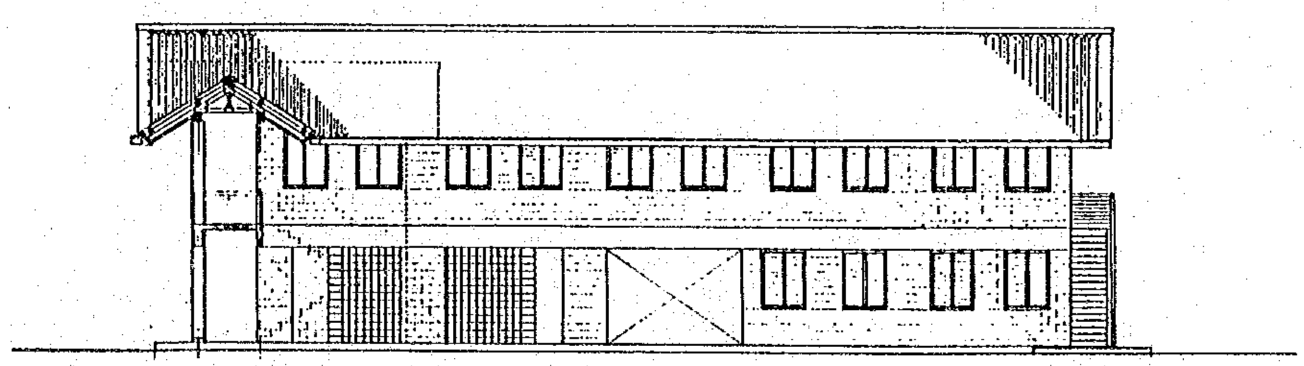
SCALE 1:200 0 1 3 5 10M



NORTH ELEVATION



WEST ELEVATION

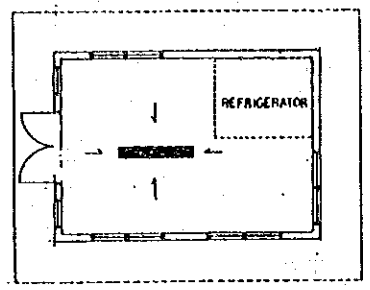


SECTION

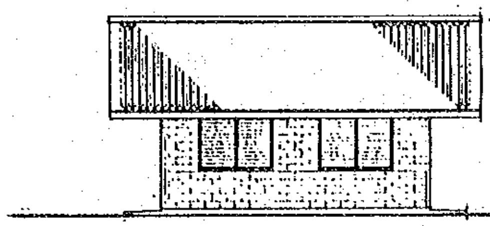
STUDENT DORMITORY

SCALE 1:200

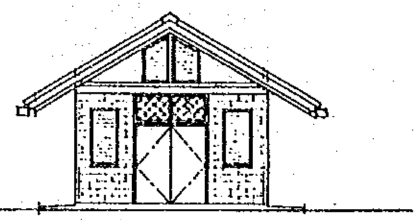
MORTUARY



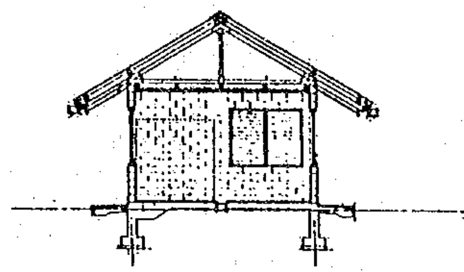
PLAN



SOUTH ELEVATION

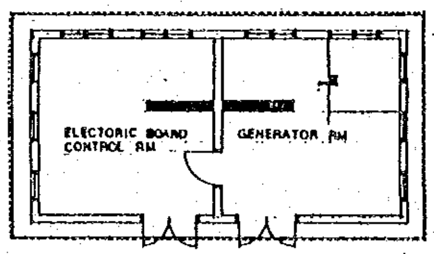


WEST ELEVATION



SECTION

GENERATOR HUT



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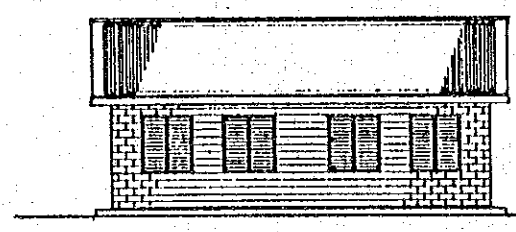
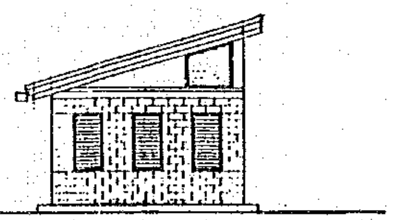
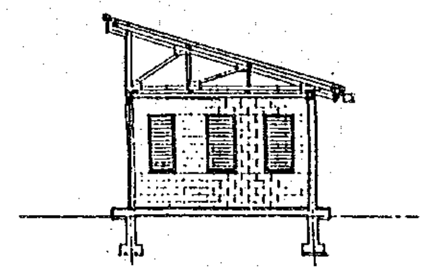


EAST ELEVATION



NORTH ELEVATION

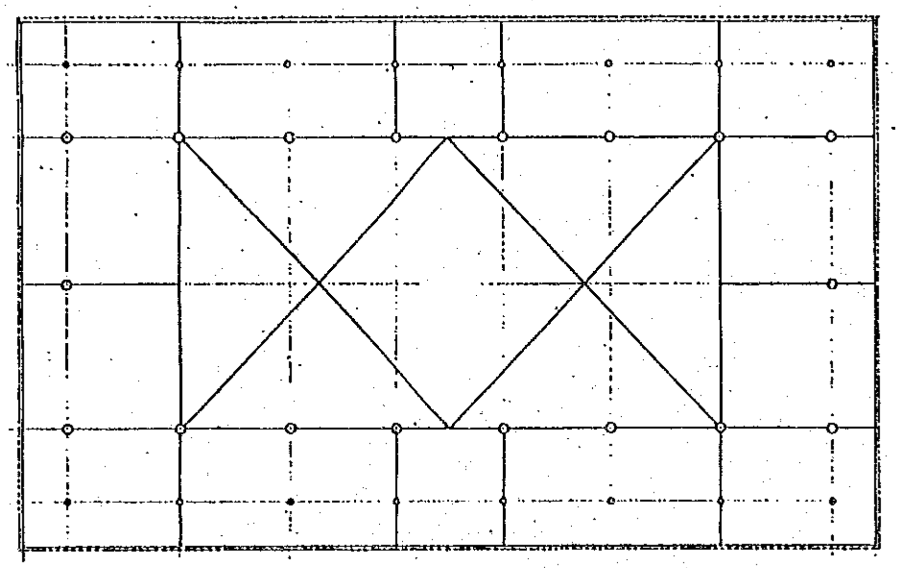


SECTION

MORTUARY
GENERATOR HUT

SCALE 1 : 200. 0 1 3 5 10M

MANEABA



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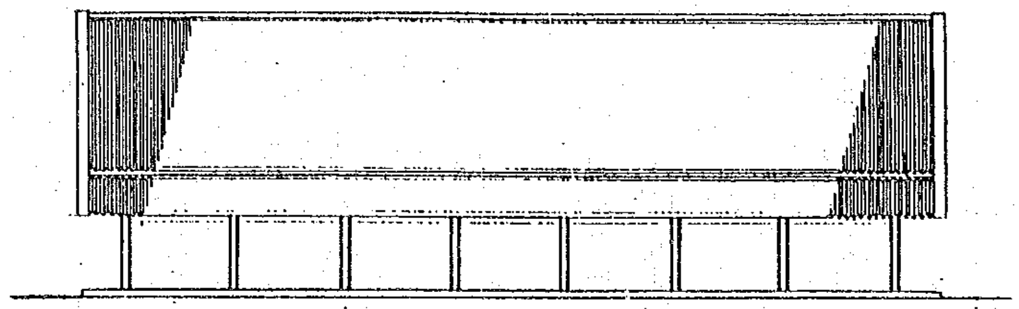
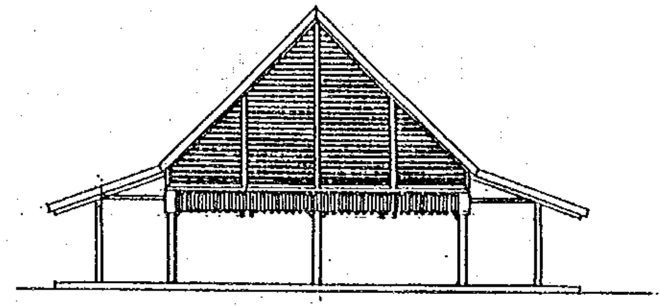
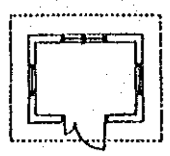


EAST ELEVATION



SOUTH ELEVATION

FUEL STORAGE



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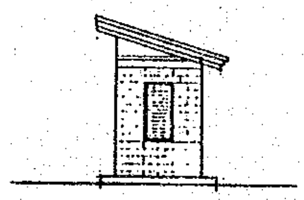
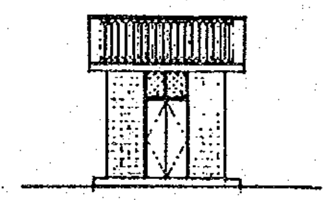
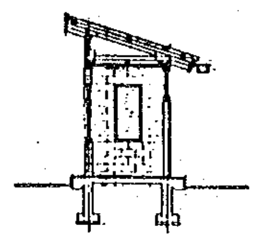


SOUTH ELEVATION



EAST ELEVATION

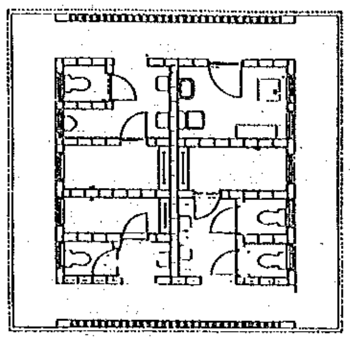


SECTION

MANEABA.
FUEL STORAGE

SCALE 1:200 0 1 3 5 10M

TOILET TYPE–1



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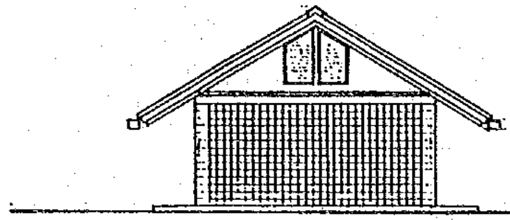

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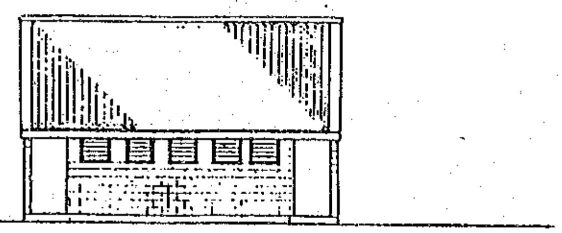

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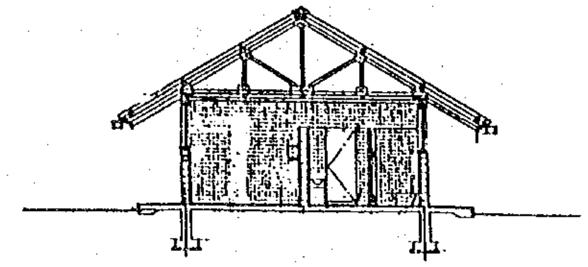
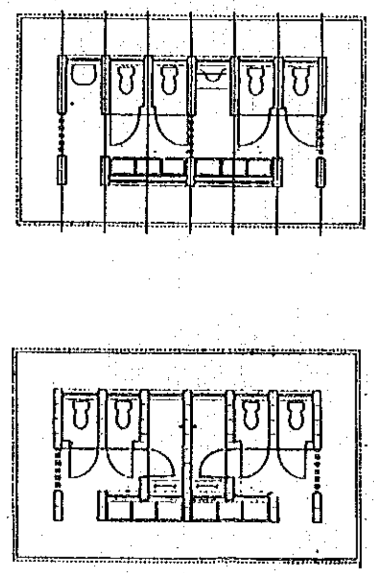
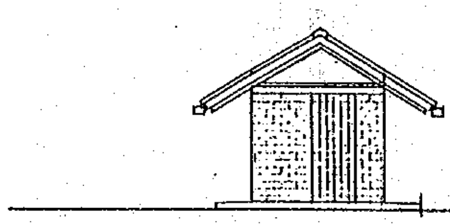


SECTION

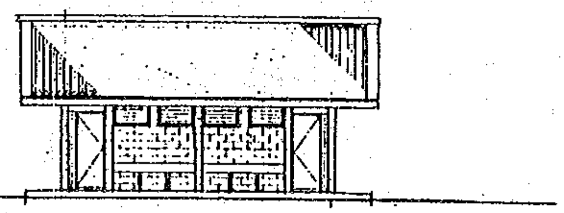
TOILET TYPE–2



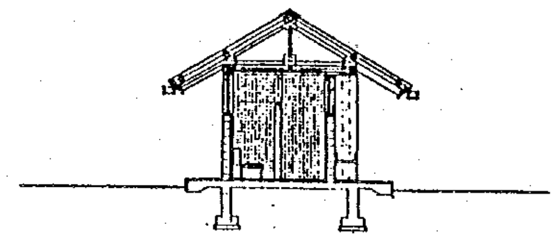
PLAN



EAST ELEVATION



NORTH ELEVATION



SECTION

TOILET TYPE–1
TOILET TYPE–2

SCALE 1:200 0 1 3 5 10M

JICA