REPUBLIC OF ZAMBIA

REPORT ON RADIO AND TELEVISION NETWORK EXPANSION PROJECT

VOLUME III

BASIC DESIGN FOR BUILDINGS AND TOWERS

FEBRUARY 1976

OVERSEAS TECHNICAL COOPERATION AGENCY

IN

JAPAN

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PART 1

OUTLINE SPECIFICATIONS

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Chapter 1. The Scope of Basic Design

Basic design related to the construction of the following facilities and to the equipments therefor is undertaken as the first-phase plan based on the long-range program under the concept of modernizing the Republic of Zambia.

Facilities	Location
Studio Centre (incl. STL tower)	Lusaka
TV transmitting station and transmitting tower	Kasompe
"	Nakupata Hill
"	Kabwe
"	Lusaka
"	Pemba
"	Tara
"	Senkobo

1.1 Legislation and Regulations, etc.

Legislation, regulations, standards and codes which are enforced or adopted in the Republic of Zambia must be complied with in the design and construction of buildings and towers, and in the design, installation and commissioning of equipment.

Besides, standards, codes, etc. for materials made in Japan are partly mentioned in this "Part 1" and to be under consideration, too.

Chapter 2. Studio Centre

The organs of the Headquarters of the Ministry of Information, Broadcasting and Tourism and those of ZBS, ZIS, ZNTB and ZANA, which belong to the Ministry, are now scattered about the city of Lusaka. It has been a strong standing desire of the Republic of Zambia to unite and consolidate these organs under a single roof.

The Studio Centre to be built at this time as the first-phase construction plan is to be intended largely for ZBS and related divisions, but ZANA closely related to news programme production and the film processing facilities indispensable to filmed programme production have also been taken into consideration, thus paying attention to repletion and reinforcement of the broadcasting service.

2.1 Site

The site selected for construction of the Studio Centre totals some 55,000 square meters in area and it extends longer in the east-west directions. The surface of the site is approximately level and the greater part thereof is covered with a limestone layer.

It is located near the central part of Lusaka, is close to the railway station and a bus stop is located along the Independence Avenue, a trunk thoroughfare in the south direction of the site.

The most convenient transportation facilities, therefore, are available for those who commute to the Centre, who appear in broadcasting and who visit it. The location, in fact, is highly desirable in all respects for construction of the Studio Centre since it offers various conveniences for the discharge of duties by those who work in the divisions housed within the Centre, for dealing with outsiders connected with the broadcasting service, for disseminating broadcasting and for publicising the broadcasting service.

The site is surrounded by roads and is convenient for pedestrian and vehicular traffic and for transporting equipment and materials in and out. However, as the road on the south side runs parallel with the Independence Avenue sandwiching a green belt in between, the site has no direct access to the Avenue.

Although no details of future plans related to the Avenue have yet been made known by the Lusaka city authorities, it is desirable either to cut down part of the green belt to build a road connecting the Avenue, or, if that is not possible, to extend the road on the south side farther westward up to the road crossing the Independence Avenue. It is hoped that either of the above alternatives will materialize by consent of the competent authorities.

2.2 Arrangement of Buildings

In consideration of the arrangement of the buildings in the total plan envisaged for the future, the locations of the facilities as the first-phase construction plan will be determined.

The space to the west of approximately the center of the site will be used for buildings the studio block and the office block with space reserved to farther west thereof for future extension of the studios.

The library and the film processing laboratory will be located where they are considered desirable in the concept of the total plan. These will be linked up with the aforementioned office block by means of connecting corridors.

Of the total site, use will be limited to the space needed to include the aforementioned facilities, but a parking space and compound paths will be fully provided in it. Around the buildings and along the boundaries of the site trees and grass will be planted appropriately.

Around the site as stated above the fence will be erected about 2 metres in height with two gateways and near by them two guard-boxes will be placed separately.

2.3 Construction Plan

2.3.1 Planning

(1) Studio Block

The basic idea will be to place the continuity and presentation functions in broadcasting at the centre and arrange the programme production facilities around them so as to achieve organic linkage between them.

The studio block will roughly comprise the centre and the television studio and radio studio sections, and these will be structurally insulated from one another.

The centre section will be a two-story structure. The ground floor will contain makeup room for performers, rehearsal rooms, offices and the building equipment room, etc.

The first floor will house television presentation studio, radio continuity and news studios, master control room, VTR room, telecine room and the rack room, etc. This section, consequently, serves as a unified centre of continuity and presentation functions of television and radio broadcasting, and this will promote efficient operation with a small personnel.

The section will also have the function of producing simple programmes. It, therefore, is provided with the minimum broadcasting function. As this section forms a very important part, which may even be considered the heart of the Studio Centre, some defence measures against possible emergency are considered to be necessary; for example, fit up the doors of some rooms which should be defended with electronic locks by remote control.

Space usable for future extension of the VTR and telecine rooms is also included.

On the north side of the centre section across the lobby will be arranged television studios and various rooms connected with them. In other words, two 200 square meter-class studios with attached storerooms and with stage set and property rooms, carpenter's shop and paint shop arranged around them will be provided. The garage for the outside broadcast vehicles and the maintenance room will also be located in this section.

The 200 sq. m-class studios will be used for producing musical, dramatic and the like programmes. In order to secure enough room height for the curtain horizont and grid pipes, the studios will have the ceiling height of three stories.

The subcontrol rooms and viewing rooms for television studios will be located on the first floor. No partition wall will be provided for the subcontrol rooms in order to facilitate communications between the director and the production staff, so that they can exert production work as a closely tied team. On the south side of the center section across the lobby will be located the radio studio group. The group will consist of one 140 sq. m. -class, one 70 sq. m. -class and four 30 sq. m. -class studios and others such as the announcers' booths, sub-control rooms, echo room and the rehearsal rooms, etc.

The 140 sq. m. -class studio will be used for musical, dramatic and the like programmes; the 70 sq. m. -class studio will be used for chamber music, dramatic, interview and the like programmes. The 30 sq. m. -class studios will be used for producing talk and similar programmes.

The 140 sq. m. -class and the 70 sq. m. -class studios will have the ceiling height of two stories.

Studios other than the aforementioned ones that require ceiling heights of two or three stories will all occupy a single floor both in the television and radio studio sections.

On the roof of the radio studios requiring the ceiling height of two stories will be erected a STL tower, but its exact location is selected in consideration of the influence of high-rise office building to be planned in future.

In the future plan the studio block is to be extended westward, and the numbers of television and radio studios as well as related facilities are to be increased.

(2) Office Block

This block will contain offices of the management, engineering, programme production departments and the like of ZBS and some facilities connected with ZANA.

Three 3-story structures running east-west will be built adjacent to the studio block. These will be arranged appropriately across the court yards. The centre and north-side buildings will be linked up with the studio block by means of connecting corridors, while the three buildings themselves will be connected with three floors of connecting corridors.

Under the plan that ventilation in the office block will depend on natural ventilation instead of providing airconditioners, the location thereof was selected in consideration of the natural conditions in Lusaka, such as the sunshine and the direction of the wind. Fixed louvers will be provided to prevent the sun shining into the offices.

The office block buildings will be provided with large rooms structurally. Aside from the rooms with specific uses, general offices will be provided with movable partition walls when any large room is to be sectioned off into smaller ones. Such partition walls will be located, as a rule, at the point half or one-third the interpost spans. This system has been adopted in consideration of the freedom of office arrangements against possible furture changes in business organizations related to the broadcasting service.

In locating the rooms in the various buildings and on the various floors priority was given to locating the offices for the programme production and the engineering departments especially where traffic with the studio block would be convenient, but dealings with the talents and performers and access to the library have also been taken into account. The offices, in fact, are to be located where it will be most convenient for the various departments concerned.

Concrete room allocation within individual departments will be made in consultation with the competent officers of ZBS, and the final decision will be made at the stage of determining the implementation programme.

The telephone switchboard for the Studio Centre will be located on the studio block side on the second floor of the center building. This switchboard equipment will be unified with the telephone switchboard for the total facilities envisaged in the future plan.

The office block will be linked up by connecting corridor with the library from the north-side building of the office block.

The visitors will enter this block from the entrance to the center building after passing over the pedestrians' path running north and south across the compound. Talents and performers going to the studios pass through the lobby 5.7 meters wide from the entrance into the studios they are headed for.

(3) Library

This three-story building will house films, tapes, records and so forth. It will be located at about the centre of the whole facilities as a library common to all departments in the future plan.

By unifying and consolidating the various libraries now established separately for the various departments of the Ministry, material and data management and control will be made more accurate and concentration of personnel will be promoted. In addition, equipment and environment more desirable for preservation and maintenance of materials and data can be secured.

(4) Film Processing Laboratory

This will be a single-story building connected with the library by means of a corridor. It will be provided with facilities needed for production of filmed programmes of ZBS. The location has been selected in consideration of its relationship with ZBS and of the future total plan.

2.3.2 Required Rooms and Spaces

Rooms contained in the various blocks of the Studio Centre and their respective spaces are as shown in TABLE 2.3.1.

With regard to the rooms in the studio block, the contents of rooms related to studios were determined on the basis of the areas and numbers of television and radio studios. The contents of the rooms related to broadcasting equipment were determined on the basis of the broadcasting equipment.

Rooms in the office block were planned on the basis of the Marcony Report.

The library has been planned principally for housing data related to ZBS but space needed for the 2nd phase has also been taken into account.

With regard to the Film Processing Laboratory, the plan was drafted on the basis of requirements as stated by the competent personnel at the time of the on-site survey.

2.3.3 Finishes

The external and internal finishes of the various blocks at the Studio Centre is as given in TABLE 2.3.2.

With regard to the part of the site outside the buildings that has been included in the present plan, the parking spaces and the compound paths will be given simple paving with asphalt.

Addenda:

It will be necessary to lay an adequate heat insulating layer directly under the roof slabs of all the buildings.

Some careful consideration for the facilities will have to be given to the protection against infestation by termite and other vermin at the stage of implementation design.

TABLE 2.3.1 SCHEDULE OF ACCOMMODATION FOR STUDIO CENTRE

	m^2
Studio block	
T.V. Studios	
Studio T-200-A	195
Control room	65
Sound lock	13
Store	42
Camera store	16
Stage crew	16
Viewing room	8
Studio T-200-B	195
Control room	65
Sound lock	13
Store	42
Camera store	16
Stage crew	16
Viewing room	8
Radio Studios	
Studio R-140-A	173
Announce booth	23
Control room	38
Sound lock	26
Store	11
Studio R-70-A	87
Announce booth	19
Control room	37
Sound lock	20
Store	11
Studio R-30-A	49
Control & projection room	32
Sound lock	18

TABLE 2.3.1 - (2)

	m^2
Studio R-30-B	49
Control room	25
Sound lock	13
Studio R-30-C	49
Control room	25
Sound lock	13
Studio R-30-D	49
Control room	25
Sound lock	13
Rooms relative to studios	
Dressing room	16
Dressing room	16
Dressing room	24
Dressing room	24
Make up room	65
Shower bath room	27
Locker room	32
Wardrobe	54
Rehearsal room	43
Rehearsal room	43
Rehearsal room	43
Rehearsal room	22
Script rehearsal room	22
Script rehearsal room	22
Band store	32
Carpenter's shop	86
Carpenter's office	11
Paint shop	54
Paint shop office	11

TABLE 2.3.1 - (3)

	m^2
Scenery store	83
Store's office	11
Property store	90
Property store's office	11
Broadcasting equipment rooms	
T.V. master control room	35
Presentation studio T-100-A	91
T-100-A control room	34
Sound lock & Store	19
Radio master control room	27
Continuity studio (A)	20
News studio	12
Continuity control room	26
Sound lock	6
Continuity studio (B)	20
News studio	12
Continuity control room	26
Sound lock	6
Continuity studio (C)	20
News studio	12
Continuity control room	26
Sound lock	6
Telecine room (incl. T.C. & V.T.R. control room)	165
V.T.R. room	65
Rack room	97
Tape dubbing room	24
Echo room	42
Sound lock	6
Script rehearsal room	11

TABLE 2.3.1 - (4)

		m^2
	Maintenance room - Central technical area	32
	Maintenance room - Studio area	43
	Maintenance room - Outside broadcast area	13
	Workshop-Outside broadcast area	17
	Workshop-Studio area	65
	Store-Central technical area	11
	Store-Outside broadcast area	13
	Store-Studio area	43
	Store-Studio area	13
Office		
	Technical office	86
	Outside broadcast office	54
	Building equipment office	43
	Programme office	65
Store		
	Script room	43
	Store-common use	5
	Store-common use	22
	Store-common use	11
	Store-common use	15
Building equipment rooms		
	Electric power receiving & distributing and standby generator room	130
	Electric power distributing room (incl. Watch room)	130
	Battery room	22
	Maintenance room	22

TABLE 2.3.1 - (5)

	m^2
Pump room	144
Air handling plant room	335
Garage	211
Office block	
Administration	119
Licensing Section	43
Commercial Section	97
Accounts Section	54
Typing pool & Registry	112
Duty & Payment	43
Guard room (incl. Guard room in Studio block)	40
Engineering	108
Sound Broadcasting	151
Home Service staff	432
General Service staff	195
Television Zambia	252
Film Section	90
Educational Broadcasting	378
Z.A.N.A.	347
Telephone equipment & operating room	32
Conference room	36
Spare room	65

TABLE 2.3.1 - (6)

	m^2
Library	
Office	32
Listening room	22
Preview room	65
Record library	151
Film library	166
Tape library	130
Library	230
Audio visual library	86
Store	32
Store	22
Store	7
Processing Laboratory	
Processing room	43
Printing room	22
Negative cutting room	14
Chemical store	5.5
Cold room	5.5
Sensitometry room	5.5
Grading room	5.5
Workshop	11
Reception room	18
Building equipment room	22

TABLE 2.3.2 ROUGH SCHEDULE OF FINISHES FOR STUDIO CENTRE

External finish		
Roof		Lightweight concrete covering on asphalt roofing
Wall		On concrete block, special paint spraying
Pilaster		Architectural concrete finishing
Louvre		Architectural concrete finishing
Door, Window		Steel, painting
Internal finish		
T.V. Studio	Floor	Linoleum flooring
	Wall	Glass fiber cloth hanging, wire mesh fastening
	Ceiling	" " "
R-140, R-70 Studio	F	Linoleum flooring
	W	Asbestos cement flat sheet boarding, painting, cloth hanging & sound reflecting & absorbing box installing
	C	Asbestos cement flat sheet boarding, painting & cloth hanging
R-30 Studio, Announce booth	F	Linoleum flooring
	W	Asbestos cement flat sheet boarding, painting & cloth hanging
	C	Asbestos cement flat sheet boarding, painting & cloth hanging
Control room, Sound lock	F	P.V.C. floor tiling
	W	Asbestos cement flat sheet boarding, painting
	C	" " "
Store, Camera store	F	Cement mortal float finishing
	W	Cement mortal plastering
	C	" " "
Stage crew	F	P.V.C. floor tiling
	W	Cement mortal plastering, painting
	C	Gypsum boarding

TABLE 2.3.2 - (2)

Echo room	Floor	Cement mortal float finishing
	Wall	Cement mortal plastering, painting
	Ceiling	" " "
Master control room, Rack room	F	Double floor (built-up type)
	W	Cement mortal plastering, painting & built-up type partition
	C	Textured sound absorbent tiling
Telecine room V.T.R. room	F	P.V.C. floor tiling
	W	Cement mortal plastering, painting & built up type partition
	C	Textured sound absorbent tiling
Dressing room	F	Flooring block finishing
	W	Cement mortal plastering, painting
	C	Gypsum boarding
Make up room Wardrobe Locker room	F	P.V.C. floor tiling
	W	Cement mortal plastering, painting
	C	Gypsum boarding
Carpenter's shop, etc.	F	Cement mortal float finishing
	W	Cement mortal plastering
	C	Asbestos spraying
Tape dubbing room Rehearsal room Work shop Maintenance room	F	P.V.C. floor tiling
	W	Cement mortal plastering, painting
	C	Textured sound absorbent tiling
Entrance hall	F	Terrazzo finish with brass strip joint
	W	
	C	Asbestos spraying, aluminium louvre fitting
Lobby	F	P.V.C. floor tiling
	W	Facing bricklaying & Cement mortal plastering, painting
	C	Textured sound absorbent tiling

TABLE 2.3.2 - (3)

Office Telephone equipment & operating room Library Spare room	Floor	P. V. C. floor tiling
	Wall	Cement mortal plastering, painting & Built up type partition
	Ceiling	Textured sound absorbent tiling
Processing room Printing room Chemical store	F	Acid proof floor tiling
	W	Cement mortal plastering, painting
	C	Asbestos cement flat sheet boarding, painting
Negative cutting room Cold room, Grading room Sensitometry room Workshop Reception room	F	P. V. C. floor tiling
	W	Cement mortal plastering, painting
	C	Asbestos cement flat sheet boarding, painting
Building equipment room (Processing laboratory)	F	Cement mortal float finishing
	W	Concrete block
	C	Asbestos spraying
Building equipment room, Standby generator room	F	Cement mortal float finishing
	W	Cement excelsior boarding
	C	Asbestos spraying
Battery room	F	P. V. C. floor tiling
	W	Cement mortal plastering, painting
	C	Asbestos cement flat sheet boarding
Garage	F	Cement mortal float finishing
	W	Cement mortal plastering, painting
	C	Asbestos spraying
Shower bath room Hotwater service room Labatory	F	Clay tiling
	W	" "
	C	Asbestos cement flat sheet boarding, painting

2.4 Structural Plan

2.4.1 Overall Plan

(1) Survey of the Ground Conditions

Survey of the ground conditions is necessary for selecting the foundation form, such as the foundation for the buildings and foundation for the equipment. Survey by boring is undertaken as the initial step.

Approximately the centre of the site will be set as the base point of survey, and the survey points will be selected at a spacing of 50 meters from the base point both in the east and west directions. The boring depth will be down to the stable ground foundation.

Samples will be taken by boring, and if soft sections are found, soil test will have to be made. Further, as supplement to the above-mentioned survey, sounding test will be made at optionally selected points in order to probe into the depth of the firm ground foundation.

(2) Earthquake Stress

Although earthquakes are reportedly infrequent, past data indicate that earthquakes are not nil. Therefore, the stress of structure should be checked up by adding horizontal force of earthquake which is 0.05 x Weight of Building.

(3) Structures

In accordance with the scale and position of the buildings, the most desirable form of construction, such as reinforced concrete, steel-framed or hollow concrete block construction, will be used.

The foundations will all be of reinforced-concrete construction.

The posts for the reinforced concrete construction parts will be provided at the standard spacing of 5.7 meters both longitudinally and laterally. The height of story will be 5 meters for the ground floor, 4 meters for the first floor and 4 meters for the second floor.

Chilled water storing tanks will be provided in the ground under the studio block.

(4) Others

Related laws and regulations will be observed with regard to the implementation design.

The allowable stress for steel materials will be based on the Construction Standards Law and its enforcement ordinance of Japan.

2.4.2 Construction of Various Parts

(1) Studio Block

Broadly divided, the studio block will consist of three structural sections. They are the television studio section, the radio studio section and the center section.

The three structural sections will be so built as to be partitioned by the two wide lobbies and corridors running east-west on the ground and first floors. This arrangement has been adopted in consideration of structural insulation so that noise and vibrations arising in the building equipment room in the center section will not bother other studio sections and so that vibrations caused by equipment in the airhandling plant rooms located on the first or the second floor in the middle of the three structural sections will not affect adjoining radio and television studios. This part, therefore, will be provided with independent posts and beams separate from those of the three structural sections. However, separation of the foundation is not considered necessary.

In the television studio section, studios themselves need the ceiling height corresponding to three floors. In the radio studio section, the studios R-140-A and R-70-A need ceiling height equal to two floors.

For these sections, rigid frames of reinforced concrete construction will be formed, and the wall will be of hollow concrete block construction. Studio sections other than these will be of one-story built with hollow concrete block wall.

With regard to the slabs, however, the entire radio and television studio blocks will be provided with reinforced concrete flooring which is structurally arranged as a unit.

The roof slabs for the television studios and the presentation studio will be of double layer for reasons of acoustic processing. The double layer construction will sandwich the beams in between.

The stairways along the studio walls will be structurally separated from the walls.

The standby generator bed will be of plain concrete construction.

(2) Office Block

The office block will comprise three buildings. They will all be three-story reinforced concrete structures with hollow concrete block wall. The eaves of each floor and the vertical louvers with 1.9 meter spacing will also be of reinforced concrete construction. The corridors connecting these three buildings will also be three-story, steel-framed construction. The eave over the main entrance will be of steel-framed construction.

(3) Library

The library will be of same construction as office block. The eaves over each floor and the vertical louvers with 1.9 meter spacing will also be reinforced-concrete construction.

The connecting corridor leading to the office block will be of steel-framed construction with a 11.4 meter span.

(4) Film Processing Laboratory

The film processing laboratory will be a single-story structure with walls built of hollow concrete block. The slabs will be of reinforced-concrete construction. The connecting corridor leading to the library will be of steel-framed construction.

2.4.3 Load Establishment

(1) Fixed Load

With studios and so forth that follow the floating construction technique, the weight of the framework assembly materials and interior fixtures is applied to the floor. With Studio T-200-A and B, the weight of the ceiling finishing materials and hanging objects like the lighting equipment is applied to the upper slabs. For these, the load capacities given below are established.

Continuity studio:	210 kg/m^2 for floor slabs
News studio:	Same as above
Studio T-200-A:	180 kg/m^2 for roof slabs
Studio T-200-B:	Same as above
Studio R-140-A:	Same as above

For the floors of the presentation studio, some parts of the broadcasting equipment rooms and of the subcontrol rooms attached to each studio on the first floor, light concrete filling of about 150mm in thickness is given as the base for finishing materials. This is because of the existence of large numbers of buried pipings and so forth. For these, the load capacity given below has been established.

Presentation studio:	270 kg/m^2 for floor slabs
VTR room:	Same as above
Telecine room:	Same as above
Maintenance room:	Same as above
Subcontrol rooms:	Same as above
Building equipment room:	Same as above

(2) Loading Weights

Loading weights are set as in the table below.

kg/m^2

Floor	Room	For floors	For rigid frames	For earth-quake
Ground floor	Stand by generator room	800	450	300
	Building equipment room	350	250	150
1st floor	Building equipment room Telecine room VTR room TV master control room Radio master control room Rack room	350	250	150
1st, 2nd floors	Air handling plant room	350	250	150
Roof	Building equipment area	800	450	300
All floors	Office	300	180	80
	Library	400	350	300
	Store	350	250	150

2.4.4 Considerations Concerning Implementation Design

As the buildings are of three-story build at the highest, the posts will be 45cm x 45cm to 50cm x 50cm, and it is desirable that the cross-section be the same for the various floors. Reasons include simplification of construction work and design aspects. However, the posts which support steel tower will be about 65cm x 65cm because of the need for burying the anchor bolts deep in the posts.

For the foundation of the side scheduled for building enlargement, as allowance is made for future load. Also, beam frame for building enlargement will be provided in the direction of extension.

For the concrete floor on the ground, a single arranging bar type will be adopted.

2.5 Airconditioning, and Plumbing Installation Plan

2.5.1 Overall Plan

In this plan airconditioning and ventilation of the studio block are to be undertaken. The central airconditioning and ventilation system will be adopted for the studio block, while for the library and the film processing laboratory, individual systems will be provided. The plan also calls for provision of plumbing equipment.

(1) Special Characteristics of the Studio Centre

The Studio Centre features the following, which are essential factors in the airconditioning design:

1) The conditions under which various rooms are used are diverse and the duration of use is long.

2) Many of the rooms, such as the television studios and broadcasting equipment rooms, contain lights and devices that generate much heat.

3) Some rooms are in the inner part of the building and have no direct access to outside.

4) For purposes of broadcasting complete prevention of noise and vibrations is necessary.

5) Protracted stopping of airconditioning seriously affects broadcasting work.

Record of mean hourly temperature taken in Lusaka reveals that even in the coldest season of the year, it is above dry bulb 0°C. In the broadcasting program transmission hours (05.00 to 23.00 hours), the period between 05.00 and 07.00 hours averages about 10°C, which is the lowest temperature of the day. After 07.00 hours, the temperature begins to rise and between 14.00 and 16.00 hours, the temperature reaches dry bulb 22°C.

Thus, Lusaka is an extremely warm place. When the outside temperature and heat generated inside the rooms are taken into consideration, airconditioning throughout the year would be necessary.

(2) Plumbing Equipment

1) Water supply as a rule will depend on the public water supply system. Water supply in the building will be provided from an elevated tank by means of gravitation water supply system.

2) Hot water supply will be divided into two systems; i.e. drinking and miscellaneous purposes. For miscellaneous purpose hot water will be supplied under the central system, while that for drinking will be supplied individually by automatic electric water heater.

3) Drainage will be classified as hereunder and the piping systems will be considered accordingly.

a) General drainage (shower, washing water)
b) Sewer drainage (toilet flush)
c) Rain water drainage

In the building, pipings for the above purposes will be provided separately, and they will be connected to the public sewerage system and the public surface water drainage system separately outside the site.

(3) Uses of Various Parts of the Buildings and Arrangement of Airconditioning Equipment Rooms

The uses of the various parts of the studio block and the arrangement of the airconditioning equipment rooms are as given in FIG. 2.5.1.

2.5.2 Airconditioning and Ventilating Equipment

(1) Purposes of Design

1) Comfortable airconditioning for 24 hours (all day)

2) Automation as far as possible in order to reduce operating and monitoring personnel

3) Simplification of equipment and devices for ease of maintenance

4) Arrangement of the airconditioning system in such a way that trouble with part of the system would not impede use of the building

Design will be executed in consideration of the above basic items.

(2) Design Conditions

1) Outdoor Temperature and Humidity Considered in Designing

Dry bulb:	The monthly mean value of daily maximum temperatures during the hot season in Lusaka is 32°C.
Relative humidity:	50%

2) Indoor Temperature and Humidity

Hot seasons:	Dry bulb (D.B.)	26°C
	Relative humidity (R.H.)	50%
Cool seasons, Rainy seasons:	Dry bulb (D.B.)	= 23°C
	Relative humidity (R.H.)	35%-60%

As shown above, the indoor temperature and humidity variations through the year range between DB 23 and 26°C, while the relative humidity ranges between RH 35 and 60%. The variations represent those occurring throughout the year and not in a single day. Monthly outdoor temperature variations and indoor temperature setting values for the entire year are given in FIG. 2.5.2.

3) Heat generated in the rooms earmarked for airconditioning and the duration of use of such rooms are as given in TABLE 2.5.1.

(3) Cooling and Heating Source System

Because of the nature of the buildings, the chilled water storing system is used to provide airconditioning throughout the year.

For the heat source equipment, an air-to-water system chiller unit will be used. A hermetically sealed circuit system will be adopted to avoid the high lime contents in the water supply and increased evaporation in the hot seasons on account of lower outdoor humidity.

The two-unit system will be adopted in consideration of the need for meeting load fluctuations, maintenance and trouble development during a year. Two chiller units, each with half the design capacity, will be provided. The chiller unit operation with the chilled water storing tank will be within 20 hours per day at maximum load, and the water temperature variation in the chilled water storing tank will be limited to within 5°C.

The following may be cited as special merits of the chiller unit operation with the chilled water storing tank system:

1) The efficiency is high and power cost saving is possible since full-load operation of the chiller units is made at all times.

2) Adaptability of the airconditioner operation to markedly fluctuating load, both in time and capacity, is good.

3) Airconditioning operation even at slight load is facilitated.

4) Even in emergencies, such as trouble developing with the cooling and heating source equipment, continued cooling operation is possible for a considerable duration of time.

5) The chiller unit capacity can be reduced.

Cooling and Heating Source Equipment

Chiller unit:	Refrigerant R-22 Compressor (hermetically sealed type): 人- △ starting system, 3φ, 400V, 50 ∿. Operation control is of full automatic system, automatically starting and stopping by means of the thermostat in the chilled water storing tank. For safety, high-low voltage pressure switch, oil pressure switch, over-current relay, freeze-free switch, fusable plug and flow switch, etc. are provided.

The schematic diagram of the cooling and heating equipment and the arrangement of the chilled water storing tank are as given in FIGS 2.5.3 and 2.5.4.

(4) Airconditioning Plan

1) Classification of Airconditioning Equipment Systems

As rooms different in the duration of use and the nature of cooling load are found in mixture, classification of the airconditioning system shown in TABLE 2.5.2 has been made in order to promote simplification of equipment and economy of operation.

For the office block natural ventilation through open windows had been adopted without making any provisions for airconditioning.

As there are cases where the heat load situation differs even in the same airconditioning system, fan coil units will be provided as finer division of classification.

Schematic diagrams of the classifications of the airconditioning equipment, the airconditioning systems and the duct routes are given in FIGS. 2.5.5 to 11.

2) Airconditioning Plant

The airconditioner concurrently used for processing outside air will be of air handling units. The units will comprise fans, water-cooling coils, humidifying nozzles, eliminators and drain pans. These will be assembled at the factory. An air filter will also be provided for the intake side of the air handling unit. The air filter will be made of synthetic resin so that it can be washed in water and used again.

The heat-absorbing cooling unit (called fan coil unit) housed behind the ceiling comprises a fan, water-cooling coil, drain pan and the synthetic resin air filter.

(5) Automatic Control Equipment

1) Control of Airconditioning Equipment of Various Systems

a) Airconditioning System for Studios

While the studio airconditioning equipment will be classified as above, they will be so constructed as to allow starting, stopping and temperature adjustment separately in accordance with the respective conditions of use.

For air-cooling, cold water is run through the water-cooling coil in the air handling unit. The chilled water is proportionally controlled by command of the thermostat in the studio in order to maintain the set temperature. Also, humidifying of water spray is made by command of the humidistat in the studio. The fan coil unit provided for the subcontrol room controls the chilled water supplied to the fan coil unit by command of the thermostat in the subcontrol room, thus maintaining the set temperature. For cooling the outside air and for swift exhaust of dust, motor damper

is used, which also supplies all the fresh air needed and exhausts it.

b) Airconditioning System for Broadcasting Equipment Rooms

As these form a group of rooms in which much heat is generated, airconditioning using a single duct of large diameter is avoided but the fan coil unit will be provided for each room to be used in parallel with the single-duct system.

Chilled water in the air handling unit is proportionally controlled with the thermostat provided in the TV master control room. The fan coil units are controlled as a unit with the thermostat provided for each room, thereby controlling the chilled water. Power supply switch is provided for each room to switch the fan coil units on and off.

c) Airconditioning System for Other Rooms

Chilled water in the water-cooling coil in the air handling unit is proportionally controlled by means of the thermostat installed in the office. Humidifying of the water spray is controlled by means of the humidistat provided for the same office.

If any room where the fan coil unit is provided, it will be possible to manually operate the power supply switch or to vary the wind volume manually, thus maintaining the required room temperature. If the outside temperature is low, room cooling will be done by supplying fresh air from outside and exhausting the room air by operating the motor damper.

(6) Ventilating Equipment

1) Rooms Earmarked for Mechanical Ventilation

Rooms earmarked for mechanical ventilation classified according the purposes of use gives the following.

a) Ventilation by cooler outside air to cool down the temperature in rooms where much heat is generated. These comprise Power receiving and distributing room, standby generator room, maintenance room (outside broadcast area), workshop (outside broadcast area), building equipment room, air handling plant room.

b) Ventilation to clear the room of any smell or vapor. These comprise battery room, lavatories, hot water service rooms, shower-bath rooms.

c) Ventilation for removing dust arising from some work done. These rooms include the carpenter's shop, paint shop and the like.

2) Ventilation Systems

The ventilation systems are as shown in TABLE 2.5.3. Also, the essential points of ventilation are given in FIG. 2.5.12. The extents of ventilation are given in FIGS. 2.5.13, 14 and 15.

Note: 1) For the ventilation of the standby generator room the shutter-coupled pressurized fan is operated under the two-position system (30°C OFF and 35°C ON) by command of the thermostat.

2) For the power distributing room, the air supply fan and air exhaust fan are interlocked and operated under the two-position system (30°C OFF and 35°C ON) by command of the thermostat.

3) The fan for clearing the room of smell or polluted air is provided without fail at the termination of the ventilating equipment to prevent leakage of such air from the duct.

4) Ventilation of the lavatories in the studio block and in the office block and that of the hot water service rooms in the office block are done in respective units.

(7) Library Airconditioning Equipment

In the library, the following rooms will be airconditioned:

The tape library on the first floor

Record and film libraries on the second floor

Because of the nature of the film library, an automatic control system will be provided to keep it at constant temperature and humidity.

Airconditioning in the library will be done with the package type air-cooled airconditioners separately provided for each room.

The locations of the airconditioners and the duct routes are as shown in FIG. 2.5.16. The control of film library airconditioning is conceived as described below.

Temperature control will be executed by switching the compressor on and off by means of the thermostat (set to DB 10°C) installed in the discharge duct. Also, the room temperature is controlled at DB 15°C ± 1°C by switching the heater on and off with the room thermostat (set to DB 15°C). For controlling the humidity, the humidifier (vapor pan type using an electric heater) is switched on and off by means of the room humidistat (set to RH 50%). The humidifier is provided with a mechanism for interlocking it with the fan and a safety device for preventing over-heating.

(8) Film Processing Laboratory Airconditioning

All the rooms in the laboratory will be airconditioned. In this laboratory, much heat is generated by the developer and the like, and smell is also generated by the chemicals used.

It is, therefore, important to provided adequate airconditioning and ventilation. Complete change of air at the rate of about 12 times an hour would pose no problems. Where heat is generated and where smell arises, hoods will be hung from the ceiling to prevent diffusion of heat or smell.

No air circulation for the airconditioner will be made but the outside air will be taken in and room air will be discharged for the entire process. As the outside air load would be big under this system of taking the outside air in the entire amount required, reduction of the load will be made by heat exchange between the outside air and the exhausted room air. The outside air will be inducted into the airconditioner after the total heat exchange is executed. FIG. 2.5.17 represents the schematic diagram of the airconditioning system.

2.5.3 Plumbing Equipment

(1) Design Conditions

1) Water Supply

The Studio Center personnel is calculated at 400 men. Required water supply is calculated as follows:

Total volume of water used (ℓ/day) = volume used by personnel x 1.3 + volume required for the developer.

The maximum volume used is estimated at 20% of the total volume used, provided per-capita volume used is 100 ℓ/ day.

Personnel increase coefficient is set at 1.3 (number anticipating outside visitors).

Volume the developer uses (ℓ/day) = 30 ℓ/min x 60 min x 6h/day = 10,800 ℓ/day.

2) Hot Water Supply

Calculation of the hot water supply volume (for general use)

Maximum volume of hot water used (ℓ/h) = volume used per number of personnel (ℓ/h) + volume used for shower (ℓ/h)

Volume used per number of personnel (ℓ/h) = 400 men x 1.3 x 10 ℓ/man-day x maximum consumption coefficient (0.2) = 1,040 ℓ/h

Volume used for shower (ℓ/h) = 50 ℓ/time x 3 times/h x 2 places = 300 ℓ/h

The heating capacity of the boiler is calculated on the basis of the temperature rise of 50°C.

(2) Equipment Plans

1) Water Supply Equipment

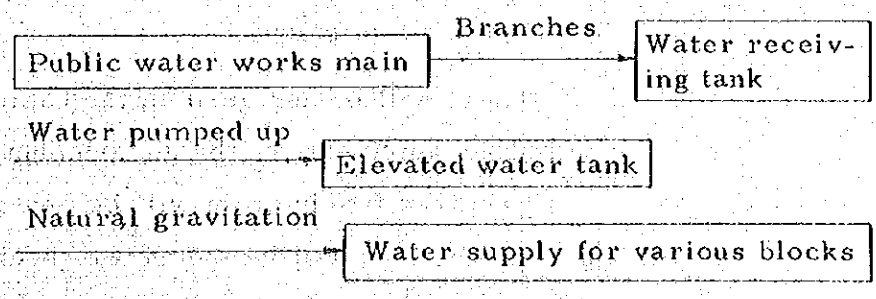
Reasons for adopting the gravitation water supply system are given in the following.

a) The system makes up for pressure shortage in the water main; it also meets the needs during emergency like water supply interruption.

b) This system is easy to handle and is subject to less trouble.

c) Hydrant pressure fluctuation is slight.

The flow chart for water supply is as given below.



The water receiving tank will be built underground of the studio block by the construction work (reinforced concrete build).

The elevated water tank will be provided at the upper part of the tower house on the roof of the office block. Two each of water receiving tanks, elevated water tanks and pumps will be provided for reasons of maintenance or for cleaning, when one set will have to be shut off.

2) Hot Water Supply Equipment

Hot water supplied for general use will be available only for the lavatories and shower-bath rooms of the studio block.

Hot water for drinking purpose will be supplied from the hot water service room provided on each floor of the office block. This room will have automatic electric water heater.

Hot water supply for general use will be prepared with an automatic electric water heater set up in the building equipment room on the ground floor, which will have a capacity of storing about 1,000 liters. Hot water will be supplied to the places requiring it through a circulating system piping. Water will be supplied to the heating equipment from the elevated tanks by gravitation. Hot water will be circulated forcibly with the circulating pump, and the piping route will be exposed to the air. FIG. 2.5.18 represents the water and hot water supply systems.

3) Fire Fighting Equipment

These will be designed on the basis of the laws and regulations applicable to the government and public offices.

Required fire hydrant will be provided for each floor. The water source will be the water receiving tanks storing water from the public water works. The fire fighting pump

will be started by pressing on the pushbutton switch provided in the fire hydrant. The fire fighting pump will be of direct starting system regardless of the power capacity.

4) Sanitary Fixture

Sanitary devices will be provided as needed in the lavatories, shower-bath rooms and other places.

The automatic water syphon system will be provided for flushing the urinals for men. The flush valve for which water is directly supplied from the elevated water tanks will be used for flushing the closets. A vacuum breaker will be provided for every flush valve so as to prevent foul water from reversing its flow.

5) Drainage Equipment

Excepting the case of pumping up when cleaning the water receiving and chilled water storing tanks, all drainage will be left to natural downward flow.

Drainage from the sanitary fixture and the like will be done via the traps.

In particular, a gasoline trap will be provided for the garage so that no oil-containing water will be drained out.

Drainage from the airconditioners (condensed water from the air handling unit and pump leaks) will be indirectly drained. Adequate air flow plan will also be considered in order to protect the water sealing compartment of the trap and to promote smooth water flow.

6) Oil Supply Piping for Standby Generator and Other Equipment

Fuel oil main tank for the standby generator, oil distributing pipes, engine cooling water supply pipes and exhaust pipes will be provided.

The fuel oil main tank will be of outdoor ground-buried type and its capacity will be 6,000 liters. The design demarcation from the engine unit side is as shown in FIG. 2.5.19.

TABLE 2.5.1 HEAT GENERATED IN THE ROOMS EARMARKED FOR AIRCONDITIONING AND THE DURATION OF USE OF SUCH ROOMS

Note: 1kW = 860 kcal/H

Room	Power of Equip-ment	Number of Persons	Duration of Use
	(kW/room)	(P/room)	
Television studio (T-200-A)	Color 80	30	10
Control room	7	7	10
Television studio (T-200-B)	Color 80	30	10
Control room	7	7	10
Radio studio (R-140-A)	3	42	10
Announce booth	0.3	2	10
Control room	3	4	10
Radio studio (R-70-A)	2.5	21	10
Announce booth	0.3	2	10
Control room	3	4	10
Radio studio (R-30-A)	2	9	10
Control room	1.5	4	10
Radio studio (R-30-B)	2	9	10
Control room	1.5	4	10
Radio studio (R-30-C)	2	9	10
Control room	1.5	4	10
Radio studio (R-30-D)	2	9	10
Control room	1.5	4	10
Presentation studio (T-100-A)	Color 40	21	16
Radio continuity studio (A)	2	10	15
Radio continuity studio (B)	2	10	15
Radio continuity studio (C)	2	10	15
Radio news studio (A)	2	4	15
Radio news studio (B)	2	4	15
Radio news studio (C)	2	4	15

TABLE 2.5.1 - (2)

Note: 1kW = 860 kcal/H

Room	Power of Equip-ment	Number of Persons	Duration of Use
	(kW/room)	(P/room)	
T.V. master control room (incl. T-100-A control room)	3	4	20
Radio master control room (incl. continuity control rooms)	4	4	20
Rack room	10	4	20
V.T.R. room	10	4	20
Telecine room (incl. T.C. & V.T.R. control room)	15	4	20
Maintenance room	1	4	20
Technical store	1	4	20
Script rehearsal room	-	8	20
Viewing room (A)	-	4	10
Viewing room (B)	-	4	10
Technical office	3	19	20
Echo room	1	2	20
Tape dubbing room	1	3	20
Band store	-	1	20
Rehearsal room (A) ($43m^2$)	-	10	20
Rehearsal room (B) ($22m^2$)	-	5	20
Rehearsal room (C) ($43m^2$)	-	10	20
Rehearsal room (D) ($43m^2$)	-	10	20
Script rehearsal room (A) ($22m^2$)	-	10	20
Script rehearsal room (B) ($22m^2$)	-	10	20
Program office	0.5	24	20
Script	-	10	20
Store (A) ($43m^2$)	-	5	20
Technical workshop	-	4	20

TABLE 2, 5, 1 - (3)

Note: 1kW = 860 kcal/H

Room	Power of Equip-ment	Number of Persons	Duration of Use
	(kW/room)	(P/room)	
Maintenance room (A)	-	2	20
Maintenance room (B)	-	3	20
Locker room	-	3	20
Dressing room (A) ($24m^2$)	-	5	20
Dressing room (B) ($24m^2$)	-	5	20
Dressing room (C) ($16m^2$)	-	4	20
Dressing room (D) ($16m^2$)	-	4	20
Wardrobe	-	5	20
Make-up room	-	10	20
Shower-bath room	-	4	20

TABLE 2.5.2 CLASSIFICATION OF AIRCONDITIONING EQUIPMENT SYSTEM

System number		Room to be included
1	T.V. studio (T-200-A)	Television studio (T-200-A), Control room, Sound lock, Viewing room (A)
2	T.V. studio (T-200-B)	Television studio (T-200-B), Control room, Sound lock, Viewing room (B)
3	Radio studio (R-140-A)	Radio studio (R-140-A), Announce booth, Control room, Sound lock
4	Radio studio (R-70-A)	Radio studio (R-70-A), Announce booth, Control room, Sound lock
5	Radio studio (R-30-A)	Radio studio (R-30-A),(R-30-B), Control room, (A), (B), Sound lock, (A)(B),
6	Radio Studio (R-30-C)	Radio studio (R-30-C),(R-30-D), Control room,(C)(D), Sound lock(C)(D),
7	Presentation studio	Presentation studio, Sound lock
8	Radio Continuity studio	Radio continuity studio (A), Radio continuity studio (B), Radio continuity studio (C), Radio news studio (A), Radio news studio (B), Radio news studio (C), Sound lock (A), (B), (C),
9	Broadcasting equipment rooms	T.V. master control room, Radio master control room, Rack room, V.T.R. room, Telecine room, Maintenance room, Technical store, Script rehearsal room, Technical office
10	Others	Echo room, Tape dubbing room, Band store, Rehearsal room (A), (B), (C), (D), Script rehearsal room (A), (B), Program office, Script, Store (A), Technical workshop, Maintenance room (A), (B), Locker room, Dressing room (A), (B), (C), (D), Wardrobe, Make-up room, Shower-bath room

TABLE 2.5.3 VENTILATION SYSTEMS

	Ventilation system	Rooms	Ventilation frequency
1	While taking outside air into the rooms by means of fans, air in the room is discharged outside with fans.	Power distributing room, Battery room	Depending on heat generated inside, 8 times/hour
2	Air intakes are provided at appropriate spots in the room and inside air is exhausted with fans. Outside air is allowed to come in naturally through the air intakes.	Scenery store and attached lavatory Airconditioning equipment room Standby generator room	8 times/hour 8 times/hour Depends on heat generated inside.
3	Air supply depends on the airconditioner-treated air taken in through appropriate intakes. Corridor air is also indirectly allowed to blow in and inside air is discharged outside with fans.	Lavatories Hot water service room Shower-bath rooms	15 times/hour 15 times/hour 8 times/hour
4	Natural ventilation through open windows	Office provided with windows in the studio block All the offices in the office block and in library.	

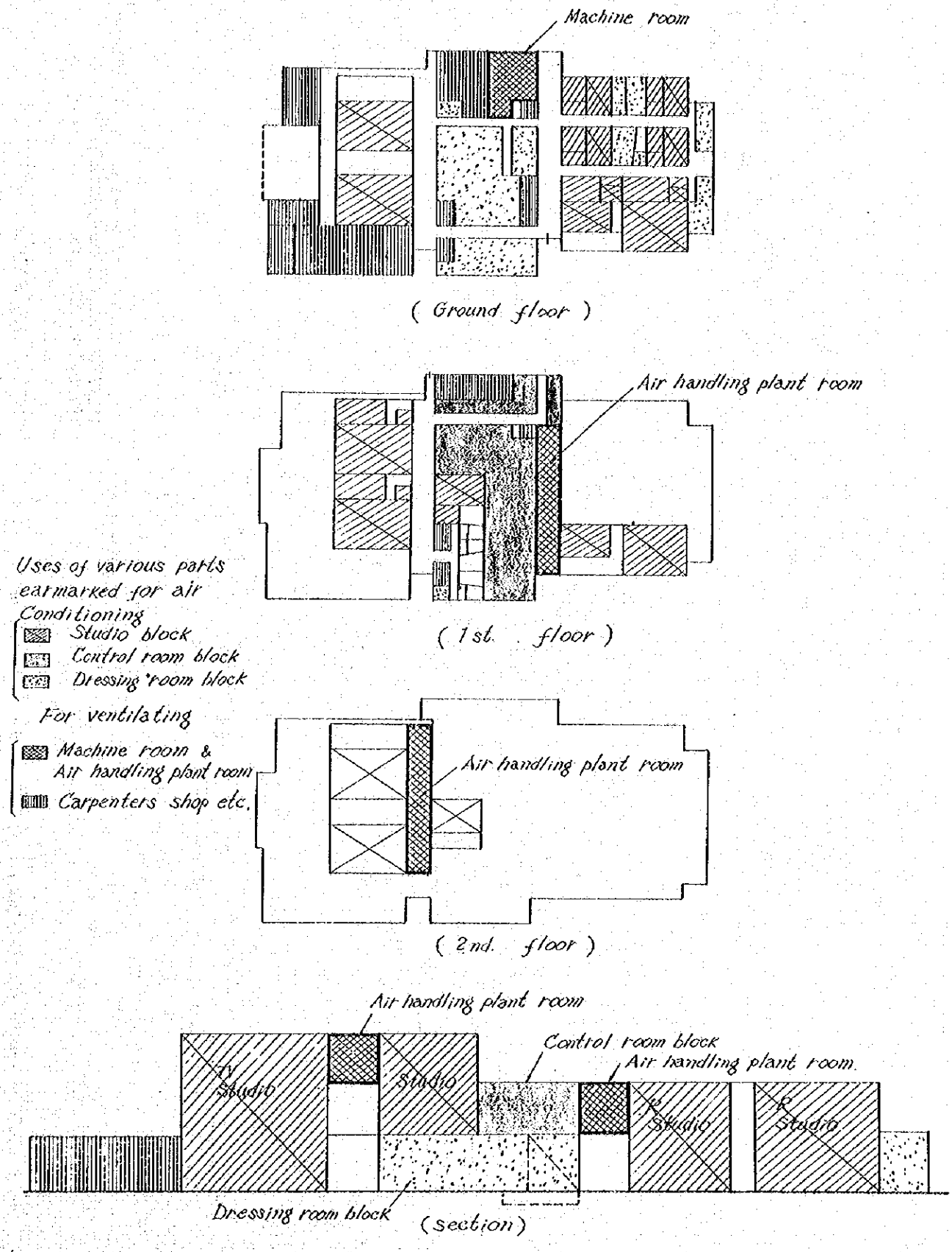
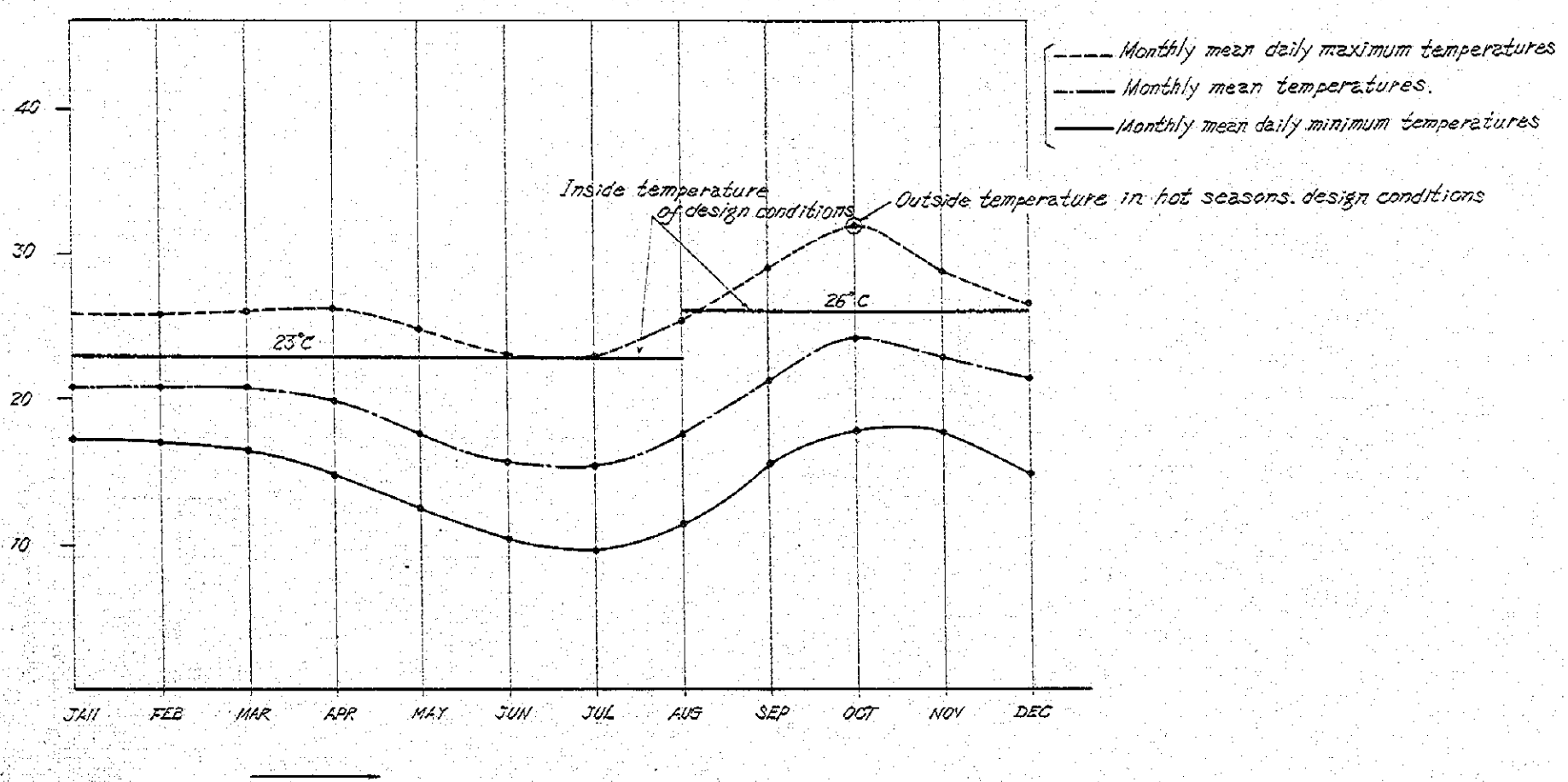


FIG. 2-5-1 MACHINE ROOM AND AIR HANDLING PLANT ROOM LAYOUT



CLIMATE DATA NO. 6 THE CLIMATE OF ZAMBIA, REVISED 1971
METEOROGICAL DEPARTMENT,
REPUBLIC OF ZAMBIA

FIG. 2-5-2 MONTHLY OUTDOOR TEMPERATURE VARIATIONS & INDOOR TEMPERATURE SETTING VALUES

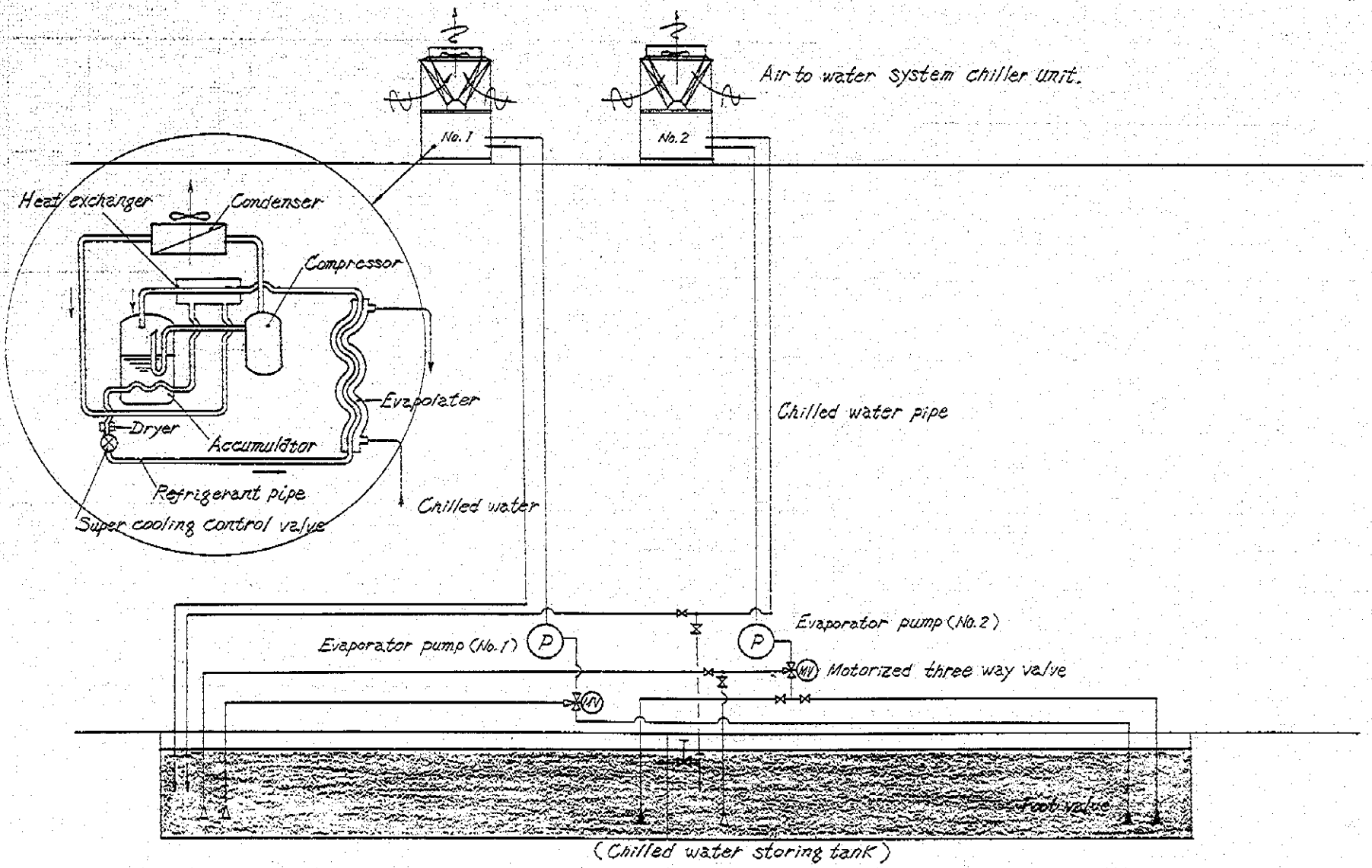


FIG. 2-5-3 HEAT SOURCE EQUIPMENT SYSTEM

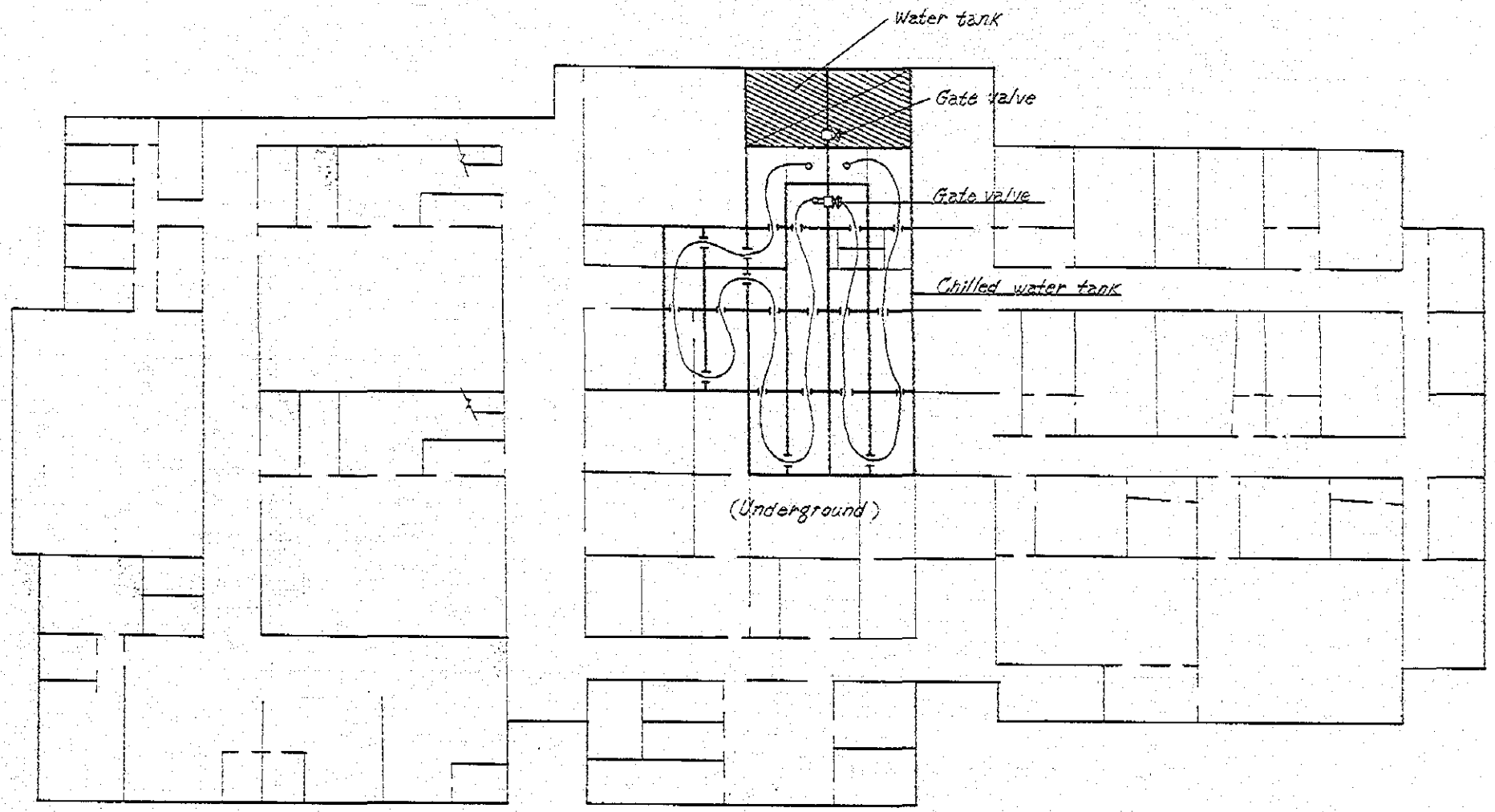


FIG. 2-5-4 WATER TANK & CHILLED WATER STORING TANK LAYOUT

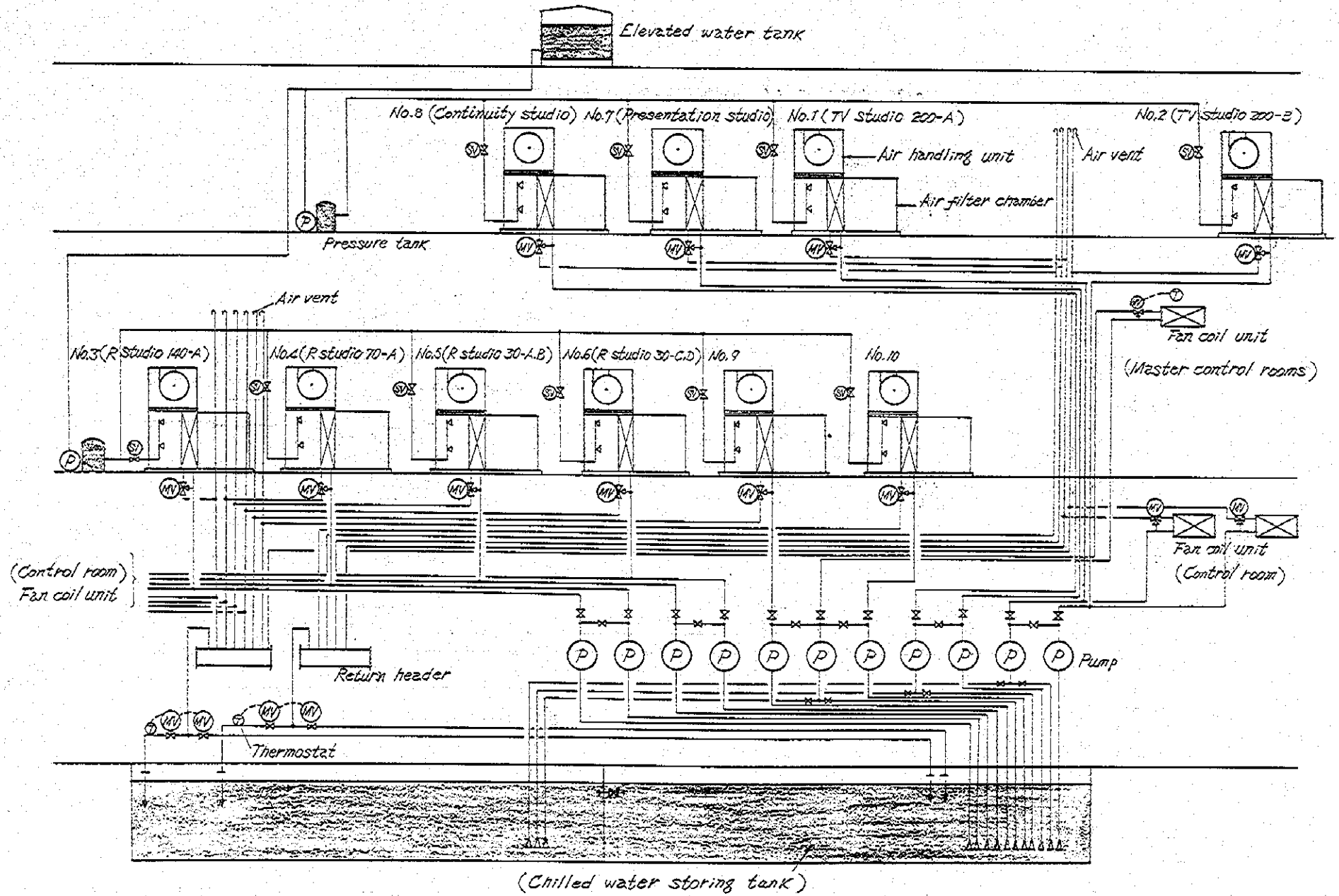


FIG. 2-5-5 FLOW DIAGRAM

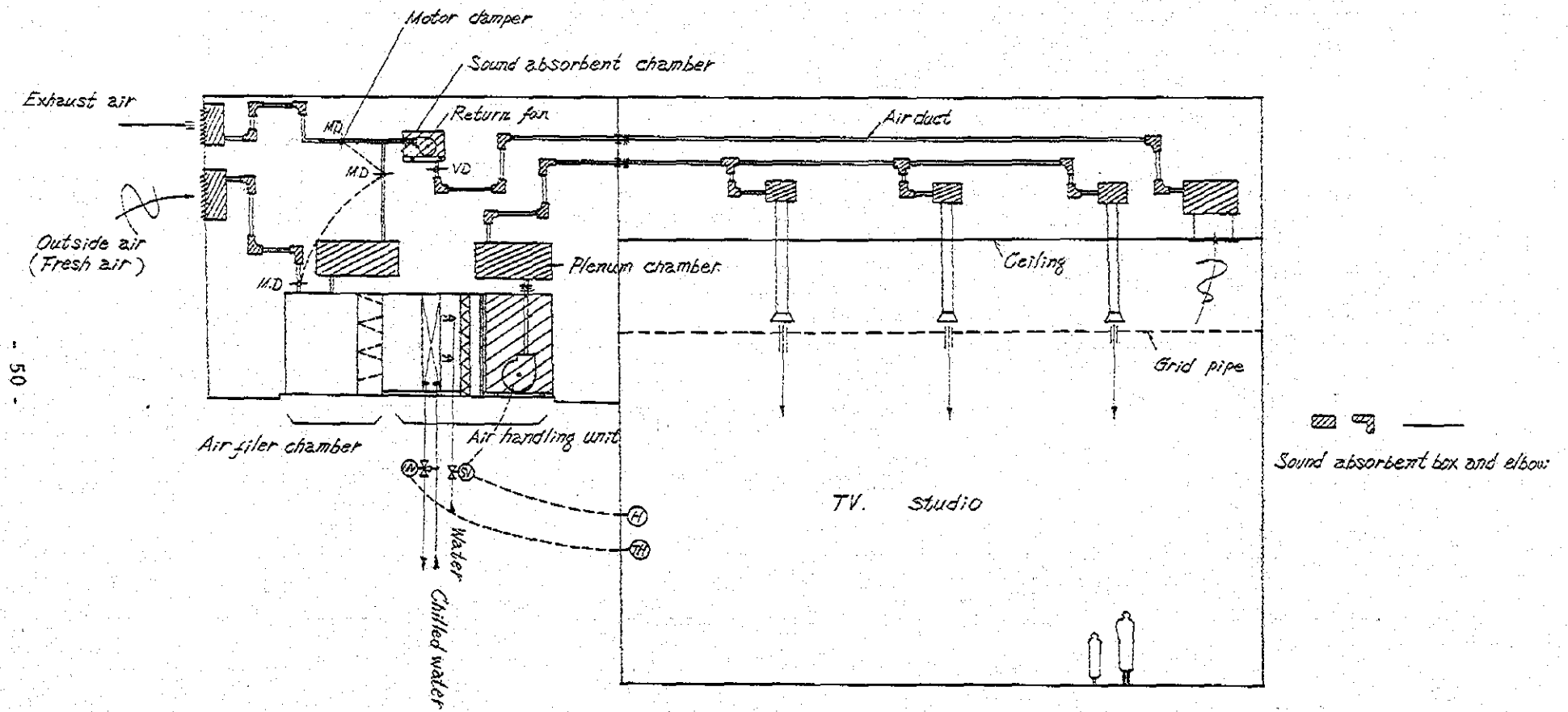
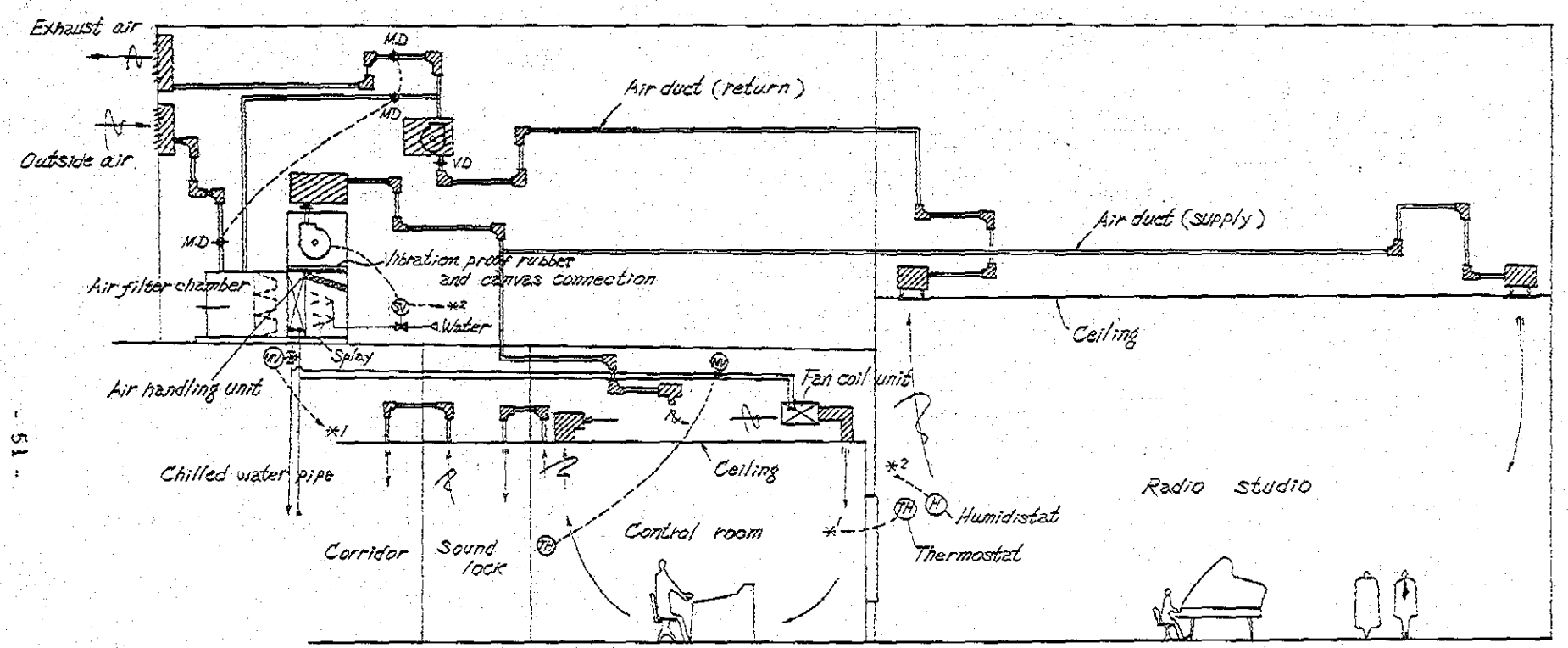


FIG. 2-5-6 AIR CONDITIONING SYSTEM OF TV STUDIO BLOCK



(Air conditioning system for sub control room of TV studio is same as this.)

FIG. 2-5-7 AIR CONDITIONING SYSTEM OF RADIO STUDIO BLOCK

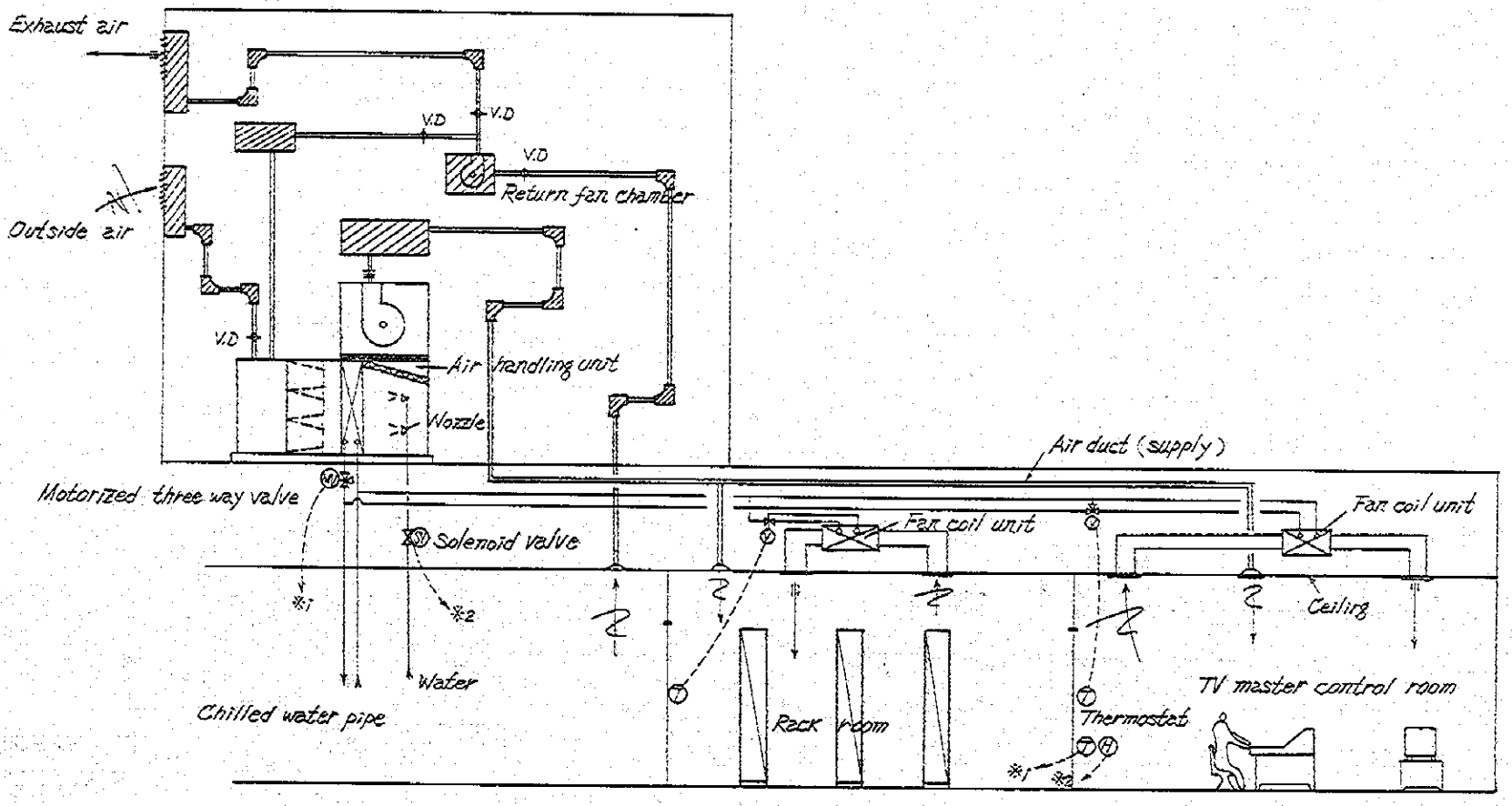


FIG. 2-5-8 AIR CONDITIONING SYSTEM OF BROADCASTING APPARATUS BLOCK

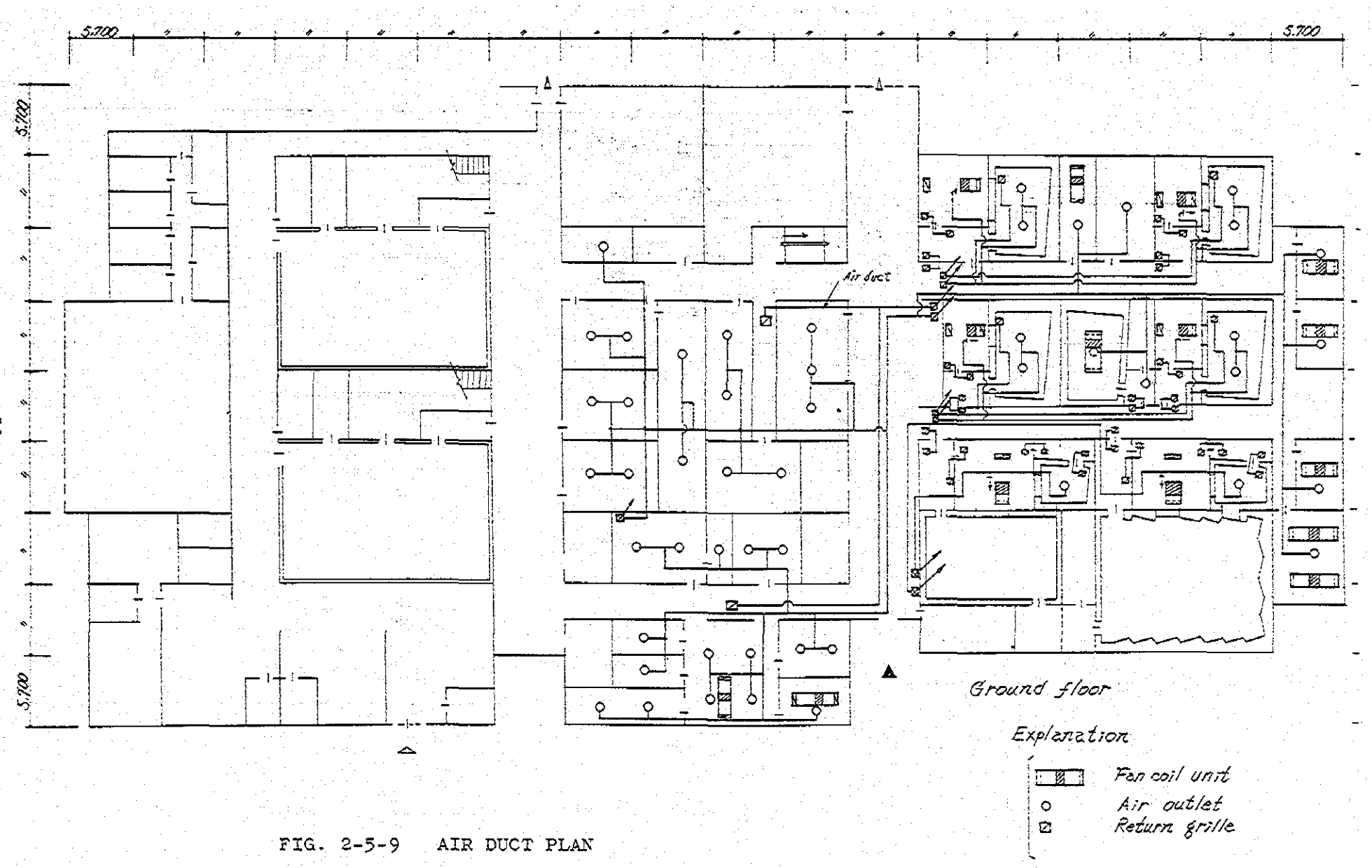


FIG. 2-5-9 AIR DUCT PLAN

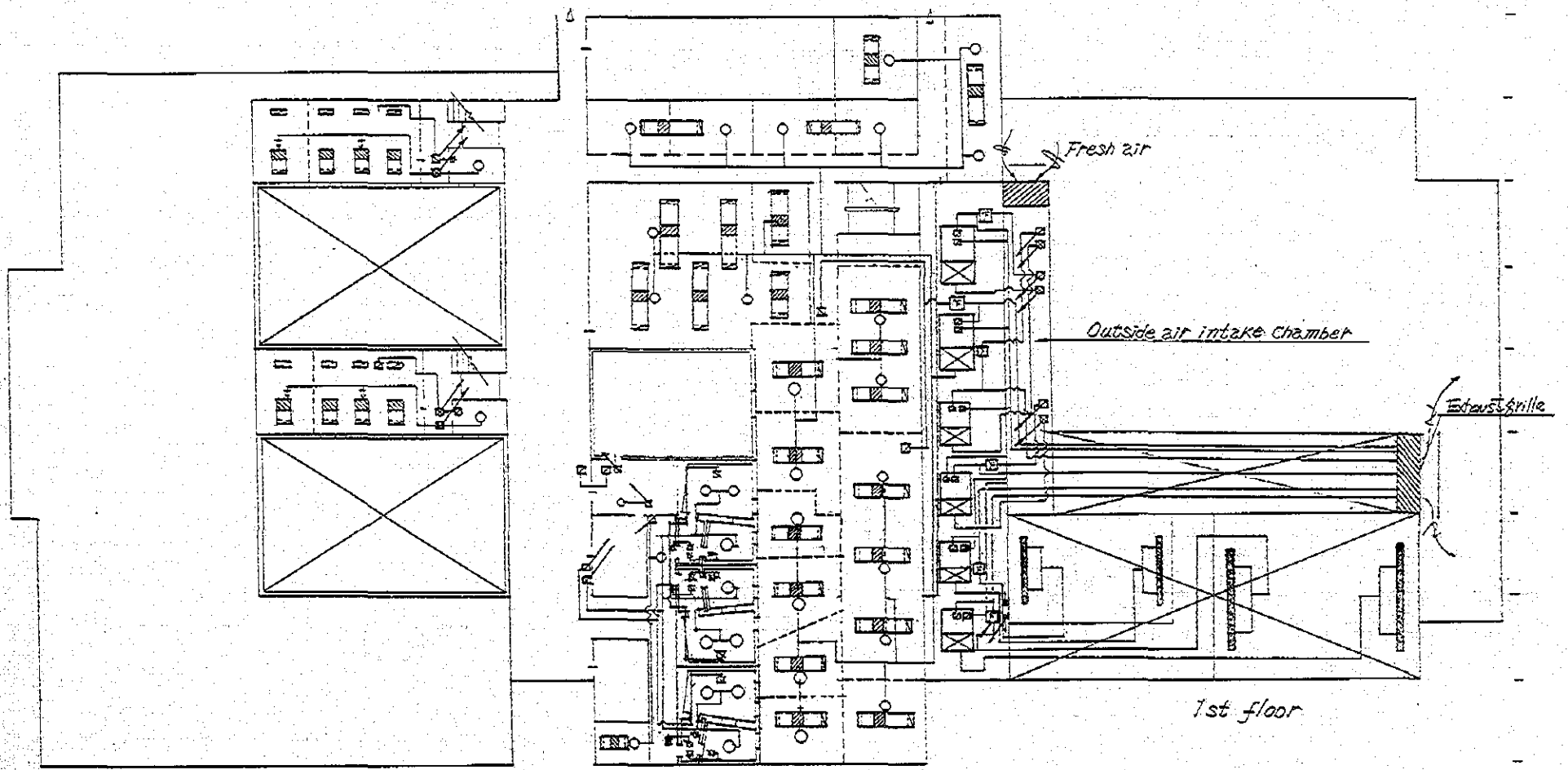


FIG. 2-5-10 AIR DUCT PLAN

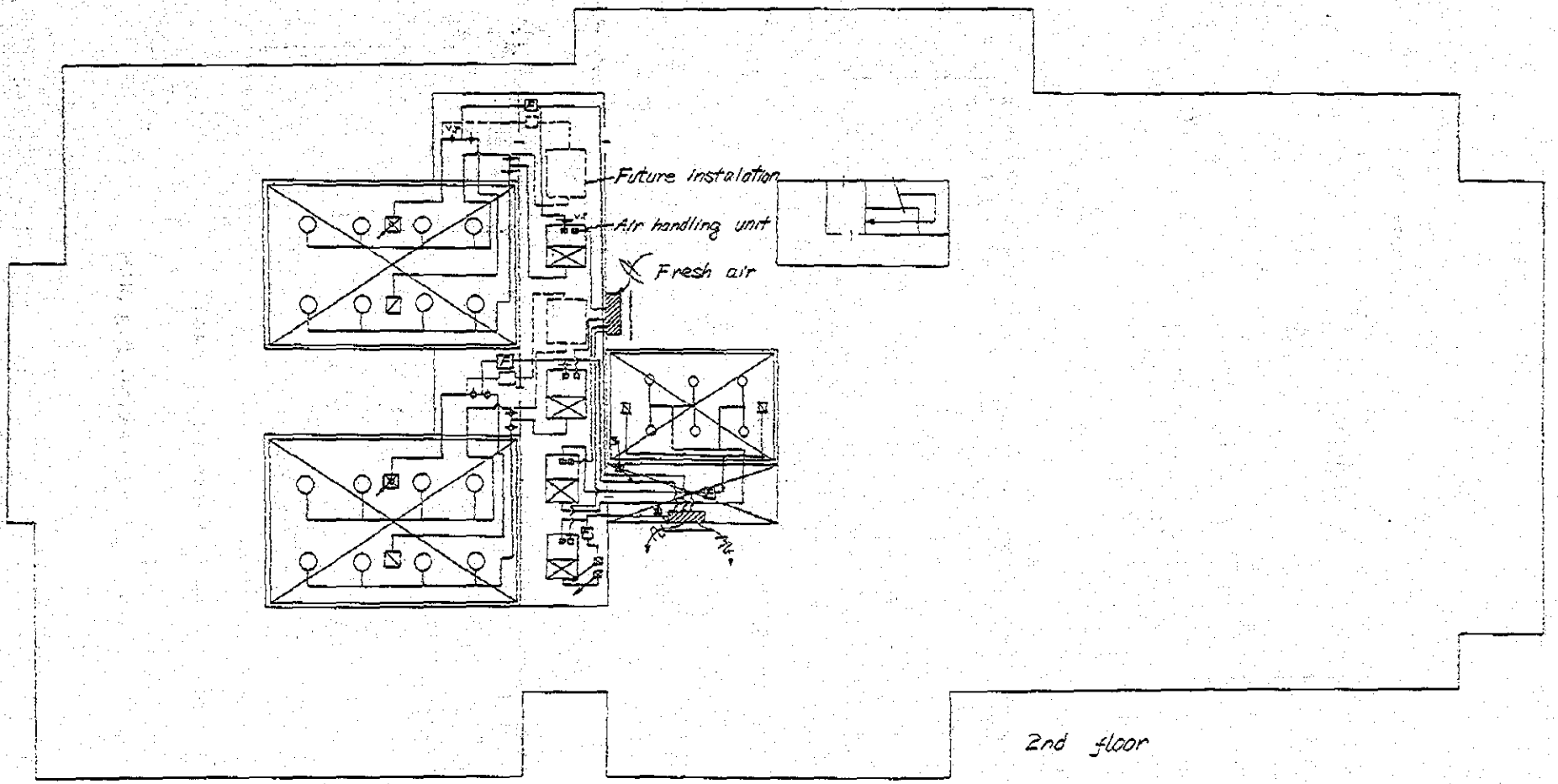
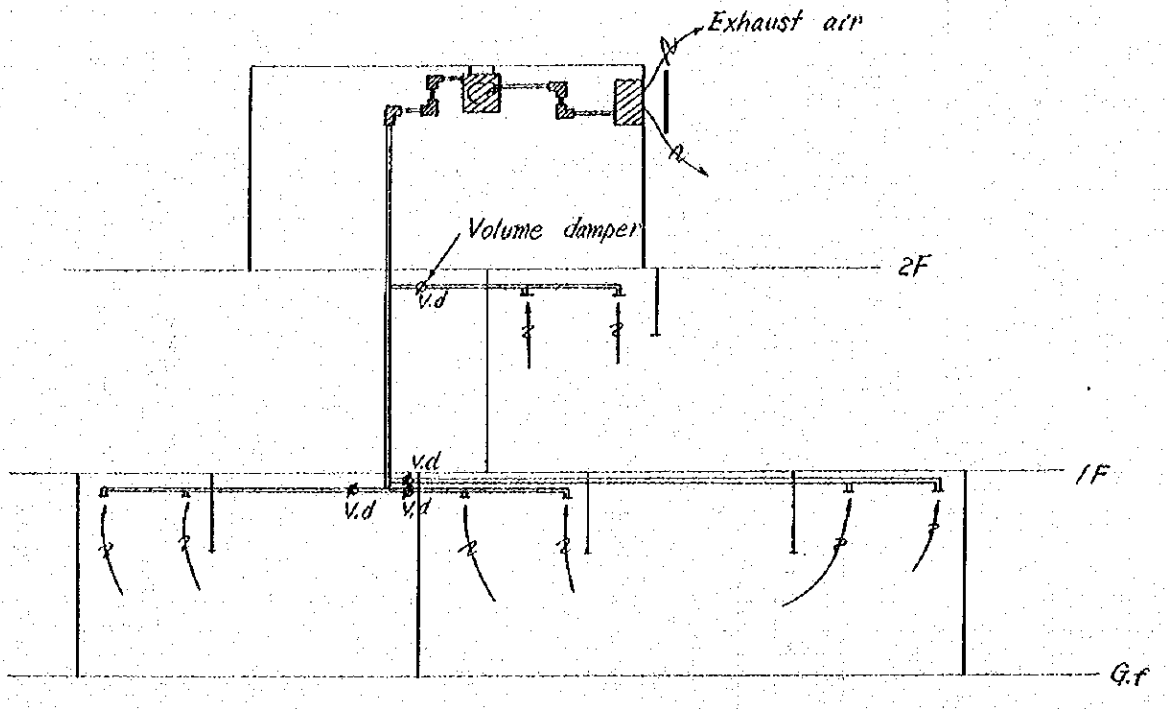
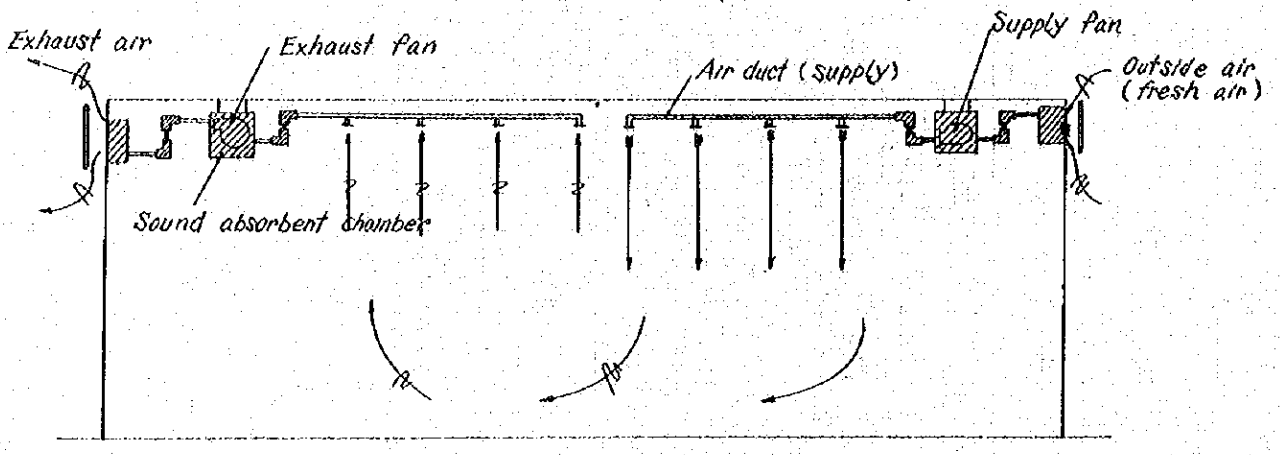


FIG. 2-5-11 AIR DUCT PLAN



Ventilation of lavatory



Ventilation of power distributing room

FIG. 2-5-12 VENTILATING DIAGRAM

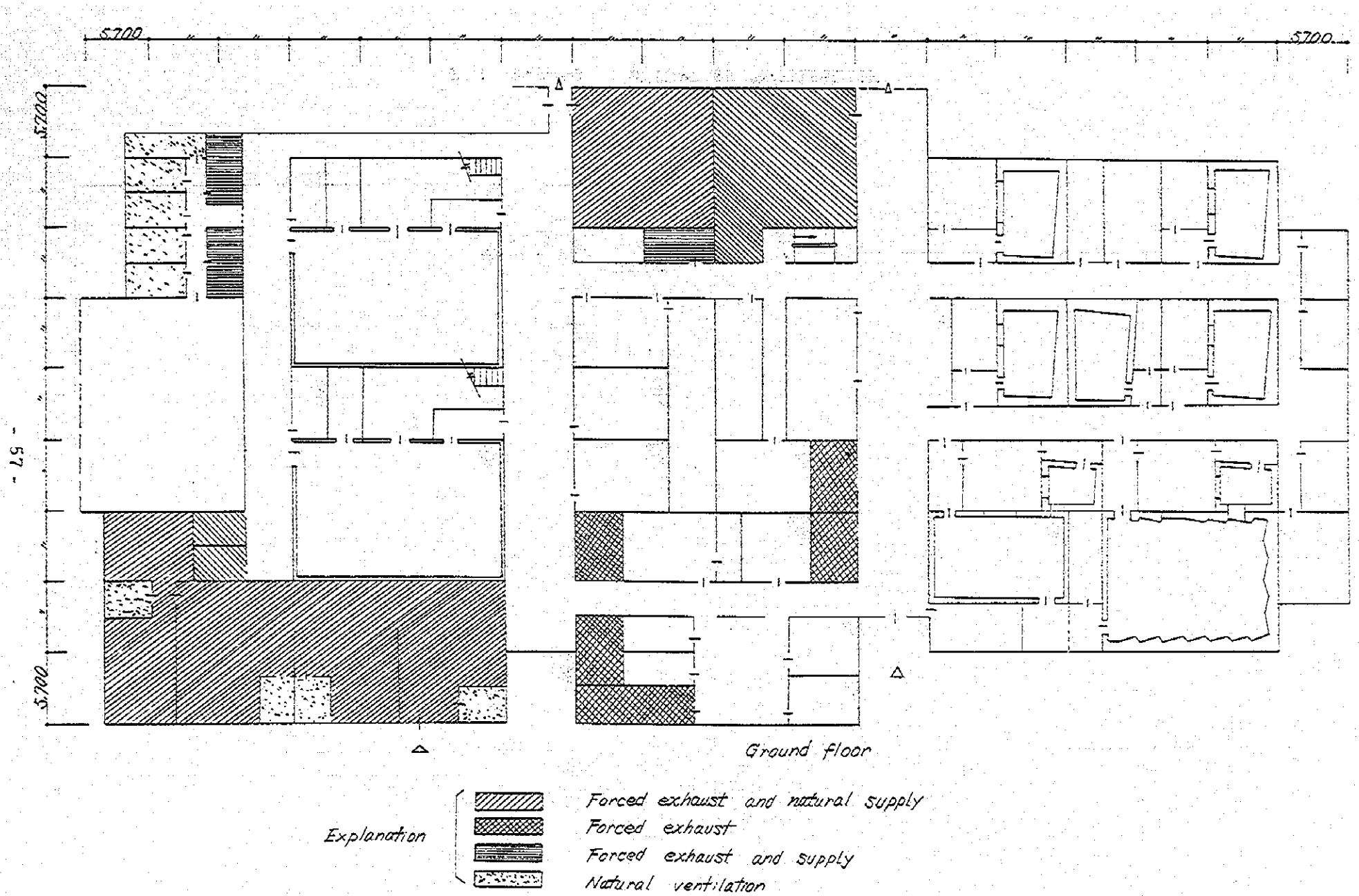


FIG. 2-5-13 EXTENT OF VENTILATION

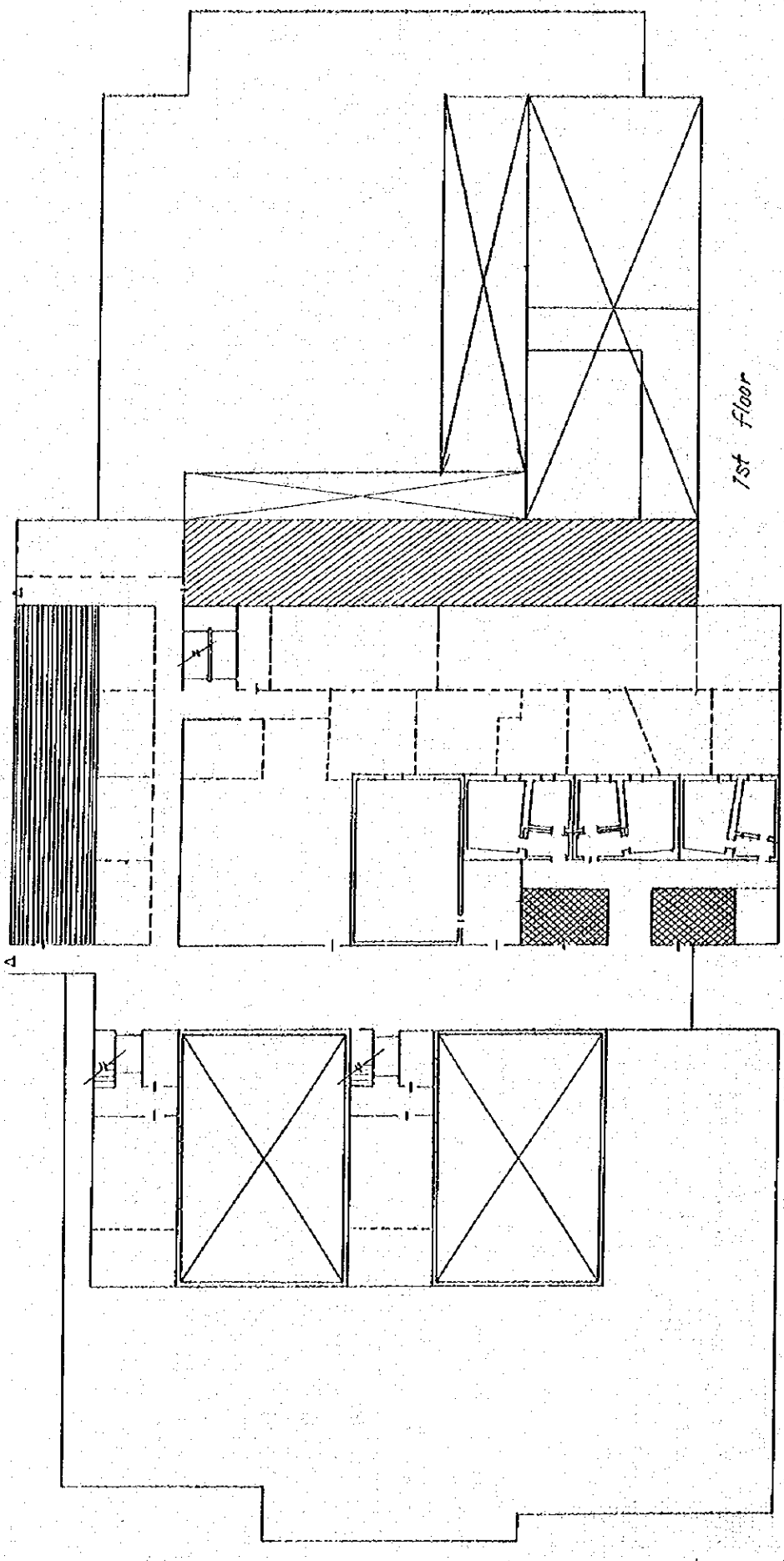


FIG. 2-5-14 EXTENT OF VENTILATION

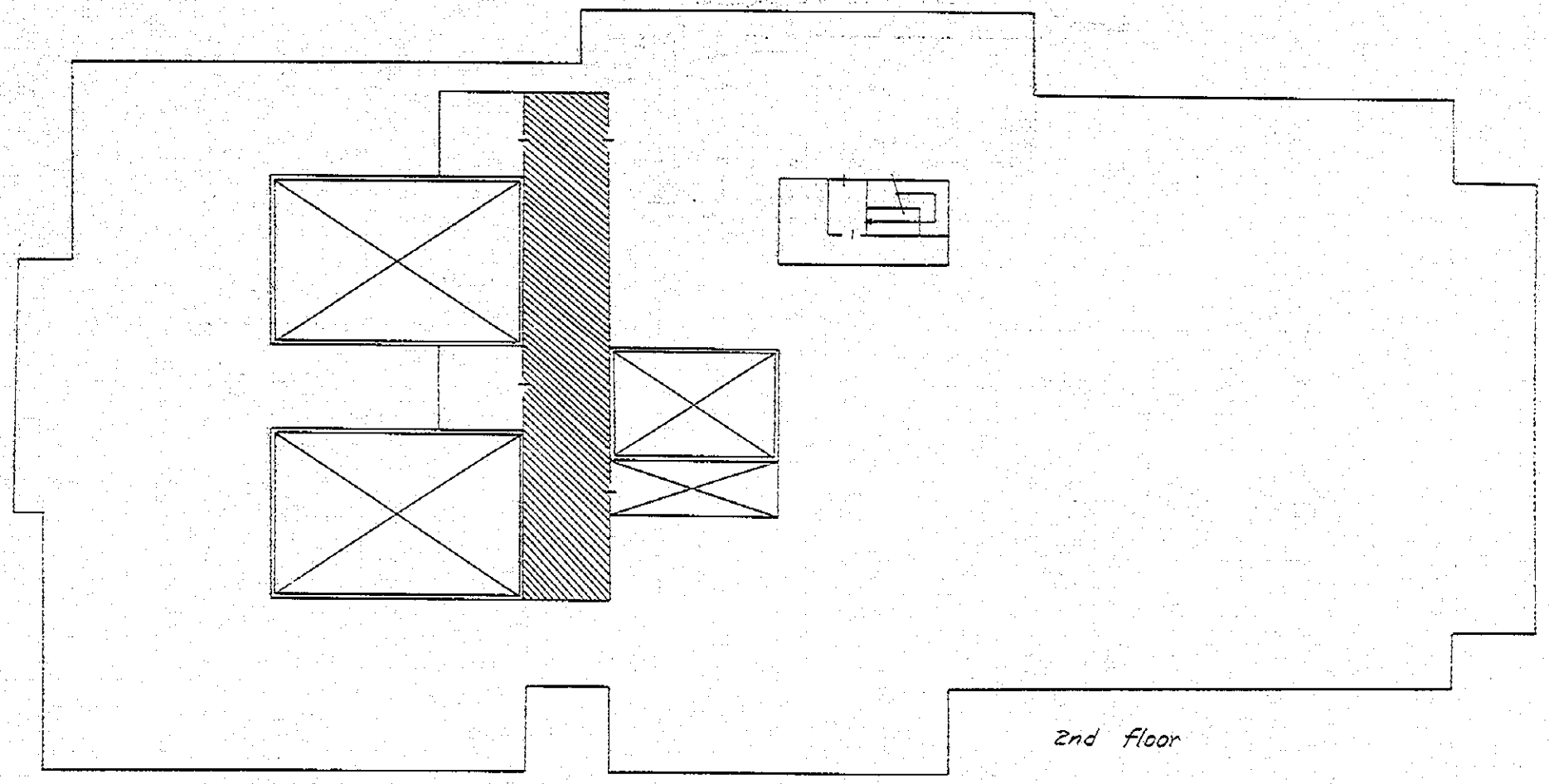


FIG. 2-5-15 EXTENT OF VENTILATION

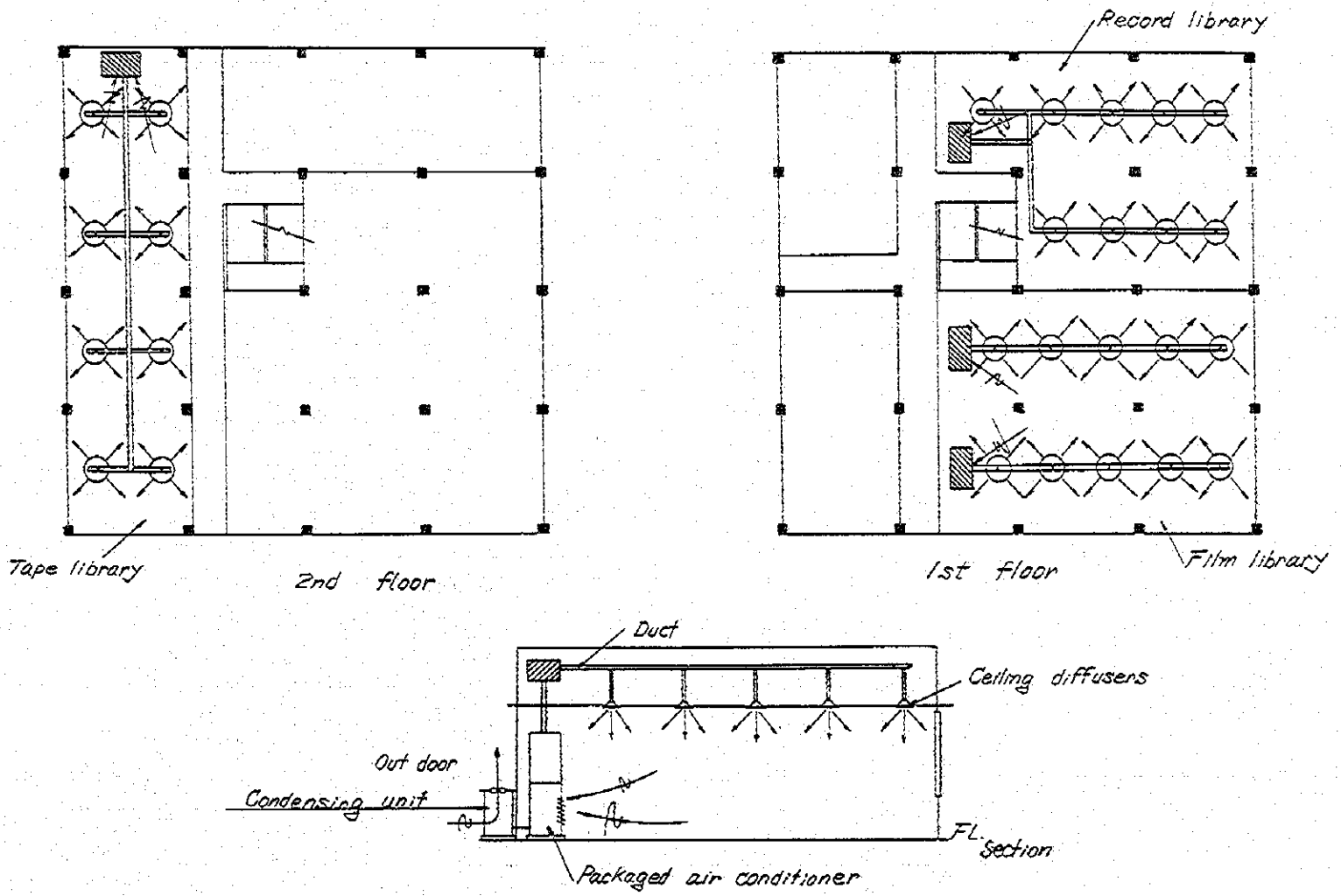
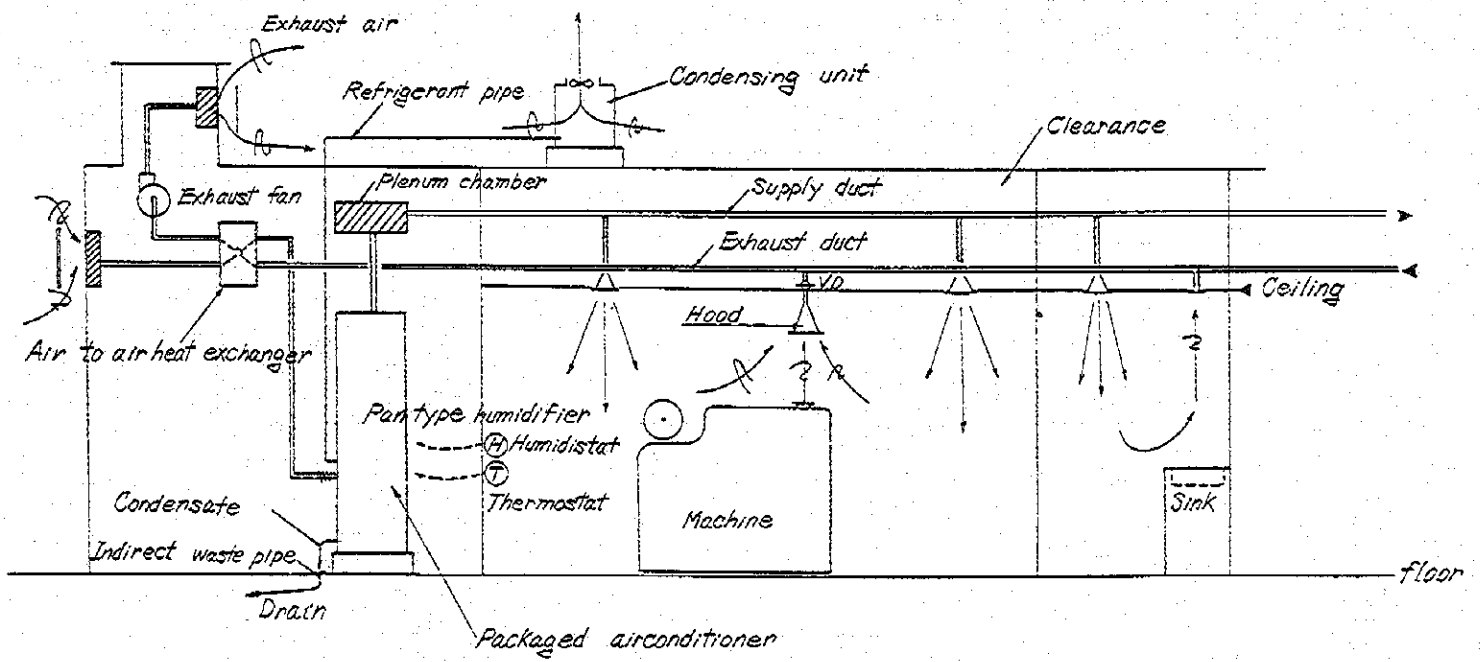


FIG. 2-5-16 LIBRARY BLOCK AIR CONDITIONING EQUIPMENT



LABORATORY BLOCK

FIG. 2-5-17 ELEVATION VIEWS OF AIR CONDITIONING EQUIPMENT

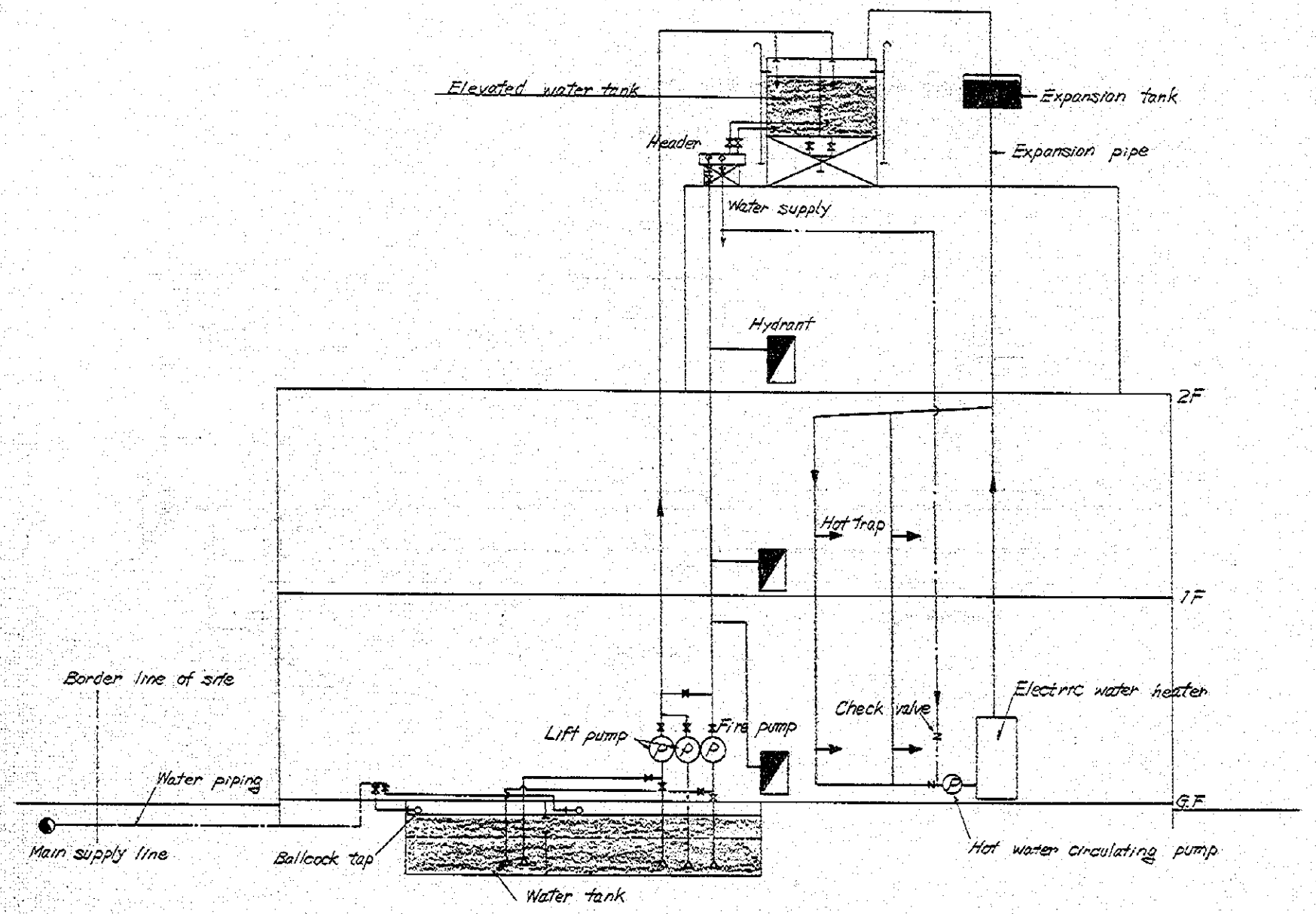


FIG. 2-5-18 FLOW DIAGRAM OF PLUMBING EQUIPMENT

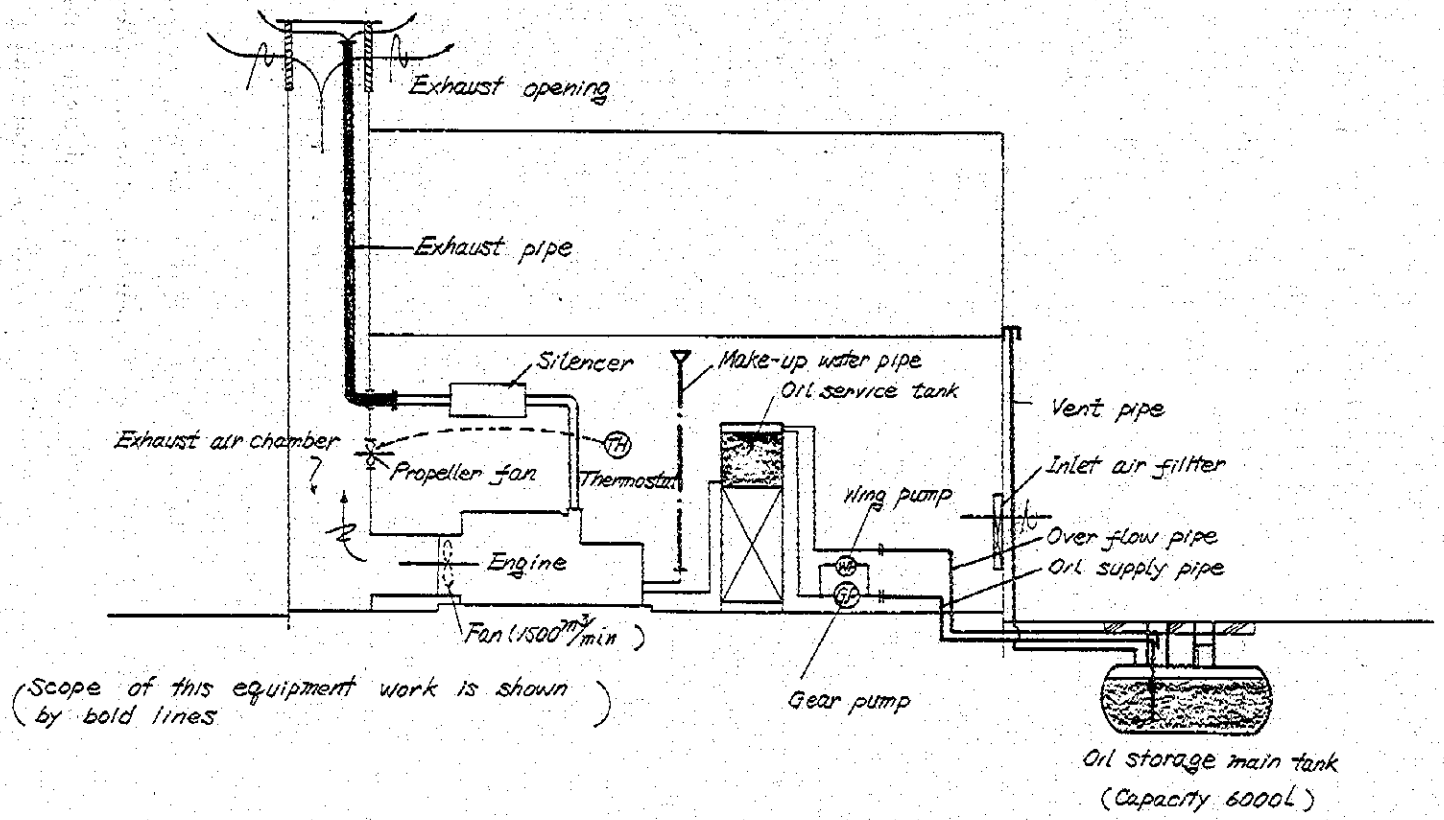


FIG. 2-5-19 ENGINE LUBRICATION AND EXHAUST PIPE

2.6 Electric Installation Plan

2.6.1 Overall Plan

(1) Power Supply Equipment

For securing stable power supply for the Studio Centre, which constitutes the pivotal facilities for the broadcasting service of the Republic of Zambia, the following points will be taken into account regarding the city source:

1) Two city sources will be provided to reduce chances of power interruption arising from trouble with the power supply lines.

2) Power supply lines free from the effect of other loads in so far as possible will be selected.

The power supply equipment installed at the Studio Centre will have the capacity to meet the total power load required for the facilities coming under the present plan plus the power load that will be required for studios and attached facilities expanded under future plan. It is particularly desirable to lay the incoming cables with a capacity sufficient for supplying power for all the buildings, including those that will be built under future plan, this time.

The standby generator will also be provided with the capacity to meet the requirements of the present plan plus those of the studios that will be increased in the future.

(2) Lighting Equipment

The general offices, radio studios, rooms relative to studios, broadcasting equipment rooms, rooms relative to programme production will be provided with lighting of 300 Lx or above. Lavatories, corridors, stairways, storerooms, machine rooms, etc. and the base lights for television studios will be 200 Lx. Also emergency lights will be provided for all

the buildings in order to secure minimum lighting during city power blackout.

(3) Motive Power Equipment

The airconditioning equipment will be feasible to automatic operation by time switch as well as to manual operation. The temperature and humidity will be automatically adjusted with the thermostat and humidistat respectively.

(4) Telephone and TV, Radio Monitor Equipments

The telephone equipment with the capacity sufficient to meet the use at the Studio Centre will be installed. In addition, telephone lines linking the studios, the master control rooms and those related to programme production will be separately provided.

Television and radio monitors will be distributed throughout the buildings, and the loudspeakers for radio monitoring will also be used for simultaneous announcements in the buildings. Automatic fire alarms also will be installed.

(5) Main Line for Broadcasting Use Equipment

The routes of the connecting cables linking the broadcasting equipments are highly important for the Studio Centre. Routes capable of accommodating the cables connecting the various broadcasting equipments will be fully secured, and the arrangement of the routes will be made in consideration of possible additions of equipments made possible by further progress achieved in technology.

(6) Central Monitoring Equipment

A watch room will be provided for watching the operating state of the various equipments related to the buildings, such as the power supply unit, motors and fire alarms.

2.6.2 Power Receiving and Distributing Equipment

(1) City Source

1) Power lines will be branched out from the high-voltage main line under control of the Ministry of Power, Transport and Works, and the high voltage power will be transformed at the electric receiving & distributing room on the ground floor as it comes in over the underground cable. The voltage will be 11,000V, 50Hz, AC, 3-phase and 3-line system.

2) Two incoming systems will be provided, and if power interruption takes place with one system, manual switch-over will be made to the other system.

3) The incoming cable will have a capacity sufficient to supply all the buildings, including those envisaged in the future plan, with required power.

4) The incoming cables will pass through the underground route into the electric receiving & distributing room. Spare incoming piping will simultaneously be laid.

(2) Power Supply Equipment

1) Receiving, Transformating Equipment

a) The electric receiving & distributing room on the ground floor will be provided with a high-tension power receiving and distributing panel and a transformer. Vibration-proof measures will be taken in installing the transformer.

b) The high-tension power receiving and distributing panel will be of cubicle type and careful attention for design of equipment will be paid to prevent dangers.

c) The receiving and transformating is of the following system; the schematic diagram thereof is shown in FIG. 2.6.1.

Receiving system:	AC 3-phase, 11000V, 50Hz.	3-line system
Transformating system:	Electric light, plug socket	3-phase 4-line 400V/230V
	Motive power	3-phase 3-line 400V
	Broadcasting equipment	3-phase 4-line 230V
	Studio lighting	3-phase 4-line 230V

d) Power supply equipment operation conditions are as follows:

Elevation:	1200 meters
Ambient temperature:	0°C - 40°C
Humidity:	90% or less
Rating:	Continuous

e) Monitoring of the operation is undertaken at the watch room.

2) Standby Generator

a) A standby generator will be provided for securing power supply during commercial power black-out and as security power supply.

b) The generator load during power black-out is as given below.

Broadcasting equipment load:	100% (excluding production lighting in TV studio)
Electric light, plug socket load:	
Broadcasting equipment room:	100%
Offices:	30%

Motive power load:

Ventilation units in the broadcasting equipment room	100%
Plumbing equipment	100%
Fire fighting pump	100%

c) The generator voltage will be 400/230V.

d) The time required for generator voltage setting from the power interruption will be within one minute.

e) A radiator-provided diesel engine will be used as the prime mover.

f) The generator will be of self-starting and self-switch-over system.

g) Vibration proofing will be provided for the generator.

h) Conditions under which the generator will operate

Elevation:	1200 meters
Ambient temperature:	0°C - 40°C
Humidity:	90% or less
Rating:	Continuous

i) Generated power voltage regulation

No load —— full load:	within 20%
At voltage setting time:	within 2%

j) The operations will be observed at the watch room.

3) Battery Units

a) Batteries will be provided for emergency lights and telephone use.

b) Batteries for emergency lighting will have the capacity for 20 minutes of lighting during power interruption or during emergency disaster.

c) The batteries will be of floating charging system, and the charging equipment will be provided in the building equipment room on the 1st floor.

4) Low-voltage Power Distributing Equipment

a) The low-voltage circuits are divided into the normal circuit and the security circuit. The security circuit is switched over to the generator at the time of power interruption.

b) Switch-over with the generator circuit is automatic.

c) The low-voltage distributing panel, which is set up in the building equipment room on the 1st floor, is of cubicle type.

d) What are included in the security circuits are the same as the loads for the standby generator in 2.6.2, 2), b).

e) Automatic voltage regulators will be provided for the circuits of the broadcasting equipment.

f) Monitoring of the operations is done at the watch room.

2.6.3 Earth and Lightning Conductor Equipment

(1) The following two types of earth will be used.

Type A: Earth resistance of 10Ω or below

Type B: Earth resistance of 100Ω or below

(2) Type A Earth

For arrester	1
For high-voltage power receiving and distributing panel	1
For TV master control equipments	1
For radio master control equipments	1
For telephone	1
For telex	1
For lightning conductor	1

Type B Earth

For low-voltage power distributing panel, low-voltage motive power equipment & standby generator	1

(3) For the earth, jointed earth rods will be used. The earth rods driven into the ground will be connected with copper wires in a net form. If it should not be possible to obtain regulation value on account of the ground conditions, the rods will be increased appropriately.

(4) A relay box will be provided at the indoor riser section and the earth wires will be connected to the various equipments via the relay box.

(5) The arrangement and construction method of the net-like earth are as given in FIGS. 2.6.2 and 3.

(6) The lightning conductor earth will be connected to the base of the steel tower from the relay box. The lightning conductor will be included among the electric equipment.

2.6.4 Power Main Line Equipment

(1) Wiring from the low-voltage power distributing panel will be extended to the electric light power panel board, broadcasting equipment power panel board and the motive power operating panel on each floor through wire pipings and cable ducts. The schematic diagram of the main line is shown in FIG. 2.6.4.

(2) Power Distributing System

Electric light, plug sockets:	3-phase 4-line system 230V
Emergency lights:	DC
Motive power:	3-phase 3-line system 400V
Broadcasting equipment:	3-phase 4-line system 230V
Studio lighting:	3-phase 4-line system 230V

(3) Voltage Drop Rate of Main Line

Broadcasting equipment circuit:	1%
Electric Light, Plug Socket Circuit:	2%
Motive power circuit:	2%

(4) The broadcasting equipment power panel board will, as a rule, be set up in the room where the equipment are set up.

(5) The electric light power panel board will be set up separately for the broadcasting equipment room and for other sections. The electric light power panel board will be divided into the normal, security and DC circuit.

2.6.5 Electric Lights & Plug Sockets Equipment

(1) Lights for the offices, radio studios, rooms related to studios, broadcasting equipment rooms and rooms connected with programme production will be more than 300 Lx, while those for lavatories, corridors, store rooms, machine rooms and base lighting of the television studios will be 200 Lx.

(2) The programme production lighting equipment for the television studios will be installed together with the broadcasting equipment installation work.

(3) Fluorescent lamps will be used predominantly, but mercury lamps will be used for outdoor illumination.

(4) 100% of the lights for radio studios, rooms connected with programme production and broadcasting equipment rooms will be provided with security circuits; 30% of lights for other rooms will be provided with security circuits.

(5) Emergency lights will be arranged for various rooms so as to obtain the minimum necessary illumination. Lighting will be automatic.

(6) The stabilizers for the fluorescent lamps provided for the studios will be installed outside the studios; no panel board will be installed on the studio wall.

(7) Emergency exit lights and evacuation guide lights will be provided at necessary spots in the buildings.

(8) As a rule plug sockets will be provided at the rate of two per interpost span (of the building).

(9) The aviation obstruction lights will be provided at the top of the steel tower.

(10) Sound insulation measure will be provided for wires that pass through the walls of the studios with floating construction.

2.6.6 Motive Power Equipment

(1) Power Control Board

1) Operating panels for airconditioning and plumbing will be set up at the place where it is convenient for operations in building equipment room. Switches will also be provided beside the various equipments.

2) The power supplies for motive power will be divided into those of security circuit and those of normal circuit, and security circuits will be provided for the broadcasting equipment rooms, electric power supply and distributing room, lavatory ventilators, water supply units and fire extinguisher equipment.

3) The operating panels will be of cubicle type.

(2) Operation

1) While the equipments will be operated with the time switch in the watch room, they can also be operated from the operating panel.

2) The air handling unit and the chilled water pump of every system will be interlocked. The fan coil unit will be operated in each room where it is installed.

3) The chiller unit will be operated by means of the thermostat provided for the chilled water storing tank.

4) The water drawing pump will be operated with the water level switch provided for the tank, while the fire-fighting pump will be operated with the starting switch installed on each floor.

5) The exhaust fan in the generator room will be operated with the thermostat, and the fan will stop when the generator starts.

6) The operation system diagram is given in FIG. 2.6.5.

(3) Temperature and Humidity Control

1) The capacity control of the air handling unit is done by regulating the chilled water volume with the cross-valve mounted on the chilled water pipe, which is operated with the thermostat. Regulation of humidity is executed by regulating the spraying water volume with the humidistat.

2) The control system diagram is given in FIG. 2.6.6.

(4) Alarms

1) The alarms indicating full or depleted water tanks, fire pump starting, trouble with the chiller unit, trouble with the boiler, etc. are sounded with lighting a lamp at power control board and the watch room.

2.6.7 Clock Equipment

(1) The master clock installed together with the broadcasting equipments will be used in common.

(2) The slave clocks will comprise the 30-second type for general use and the 1-second type provided for the broadcasting equipment rooms.

(3) As a rule, each room will be provided with a slave clock.

(4) A terminal board will be provided for each floor to allow branching out of wiring to slave clocks. This terminal board

will be used in common for the clocks, telephones, television and radio monitors and intercommunications devices.

(5) The schematic diagram of wiring for clocks is as given in FIG. 2.6.7.

2.6.8 Telephone Equipment

(1) The telephone cable will be laid underground and will be led into the telephone equipment and operating room via the distributing frame in the rack room on the 1st floor.

(2) The private branch exchange will be of automatic system.

(3) The number of channels will include 200 extensions and 40 office channels.

(4) The private branch exchange and the attendant board will be installed in the telephone equipment and operating room.

(5) The schematic diagram of wiring for the telephone is given in FIG. 2.6.8.

2.6.9 TV and Radio Monitor and Intercommunication Equipment

(1) TV and Radio Monitor Equipment

1) The outputs of the television and radio receivers installed together with the broadcasting equipments in the rack room are amplified and power is supplied to the radio speakers and television sets.

2) The amplifier is set up in the rack room.

3) Arrangements are to be made so that the radio speaker and the television set can be installed in any room.

4) The radio speaker will be used concurrently as an emergency announcement speaker.

5) The radio speaker is installed in every room except the storeroom and the machine room. Television sets are

installed in the rooms connected with studios, rooms connected with programme production, offices and so forth as need arises.

6) The TV and radio monitoring systems are shown in FIG. 2.6.9.

(2) Intercommunication Equipment

1) Intercommunication Telephones

a) Telephone sets for keeping contact between the rooms connected with programme production and the broadcasting equipment rooms are provided.

b) The terminal board for telephone contacts is set in the rack room, and wiring is extended to various rooms via the terminal board on each floor.

c) A terminal board will be provided for the telex room and this will be connected with the main distributing frame in the telephone equipment and operating room.

2) Simultaneous Emergency Communications Equipment

a) A complete set of devices for simultaneous announcement throughout the buildings in case of emergency is provided in the watch room.

b) For the speakers, those for radio monitoring will be used in common.

c) In case of emergency announcement, radio monitor will be cut off to give priority to the announcement.

2.6.10 Communication Main Line for Broadcasting Use

(1) The coaxial cable for television channel and the cable for radio channel will be laid underground and led into the rack room.

(2) The communications main line piping for broadcasting use will be arranged so as to meet the future requirements, when the broadcasting equipments will have been increased. Where

large numbers of cables are to be laid, cable racks or cable ducts will be used.

(3) The wiring pipes that run through the walls of the floating construction studios will be provided with sound insulation measure.

(4) Communications line piping system is shown in FIG. 2.6.10.

2.6.11 Fire Alarm Equipment

(1) Automatic fire alarms and manual fire signal generators will be installed in the buildings.

(2) The receiver will be set up in the watch room.

(3) In order to indicate the floor where the fire has broken out, when the fire alarm operates, an indicator and an alarm bell will be provided for each floor.

(4) Provision of some power source for the automatic fire alarm will be considered so that it will work even during power interruption.

(5) Regulations of the Republic of Zambia will be observed with respect to the locations of the sensors and the watch area.

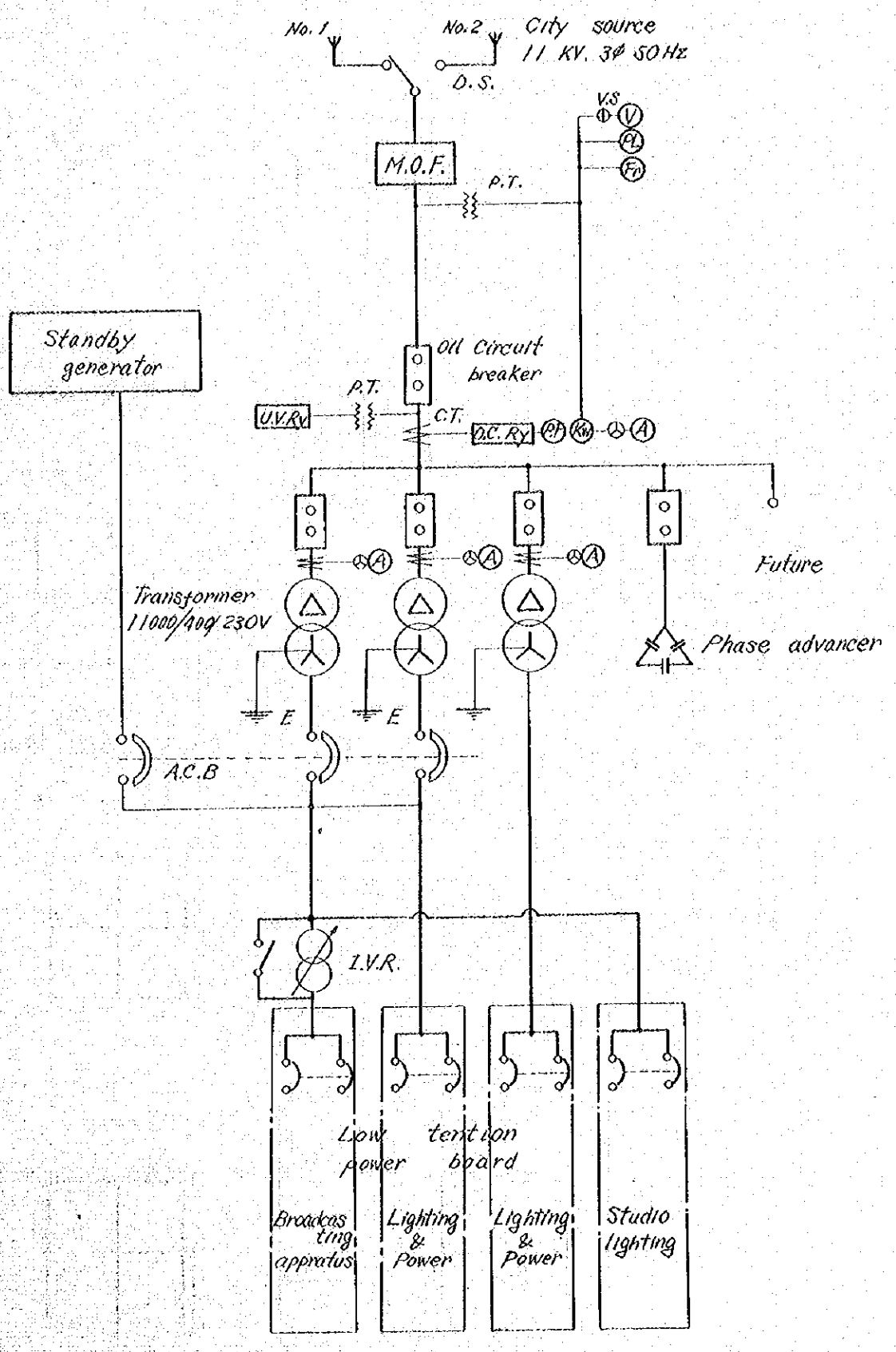


FIG. 2-6-1 INCOMING LINE & DISTRIBUTION SYSTEM

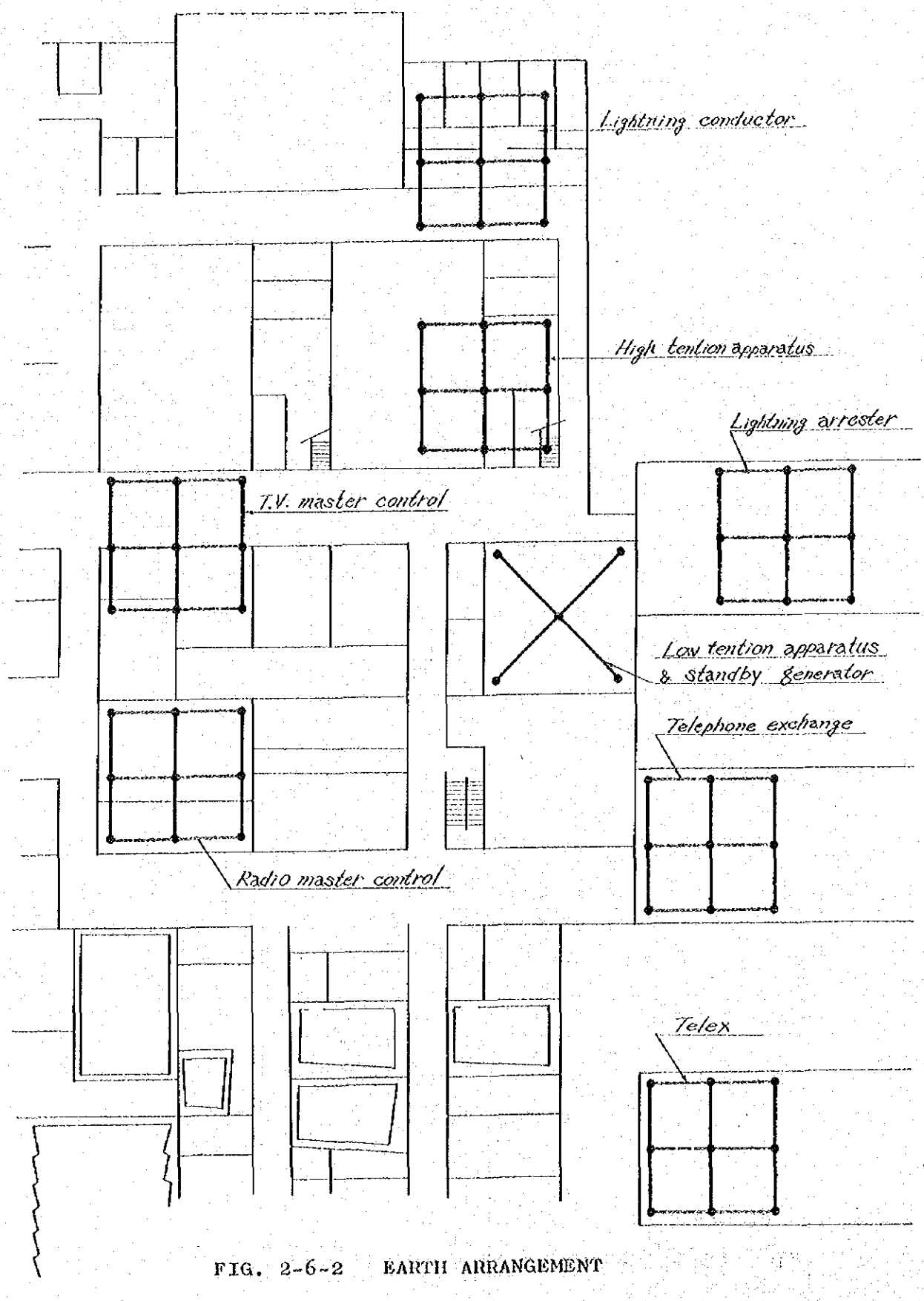
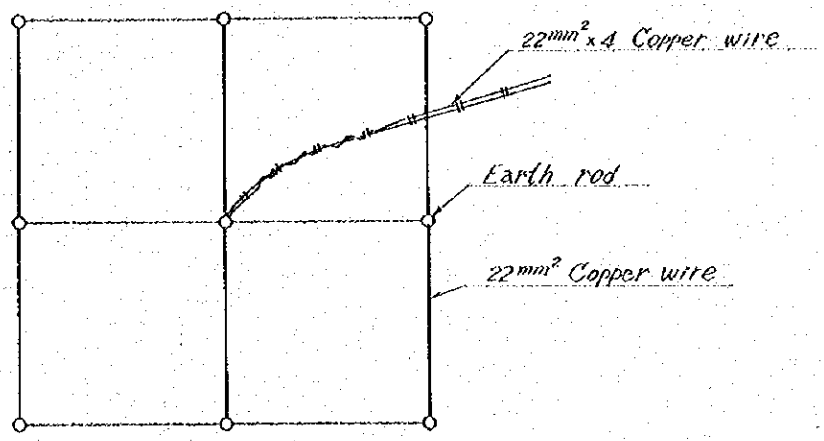
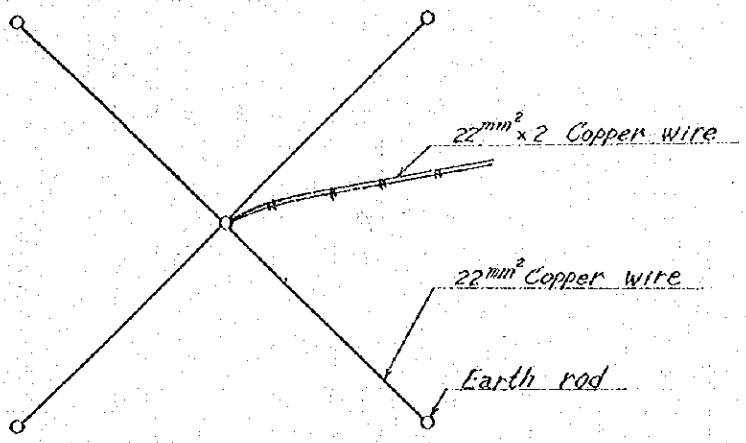


FIG. 2-6-2 EARTH ARRANGEMENT

A type



B type



Earth depth

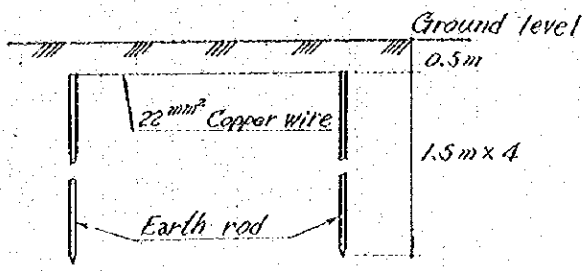


FIG. 2-6-3 EARTH DETAIL

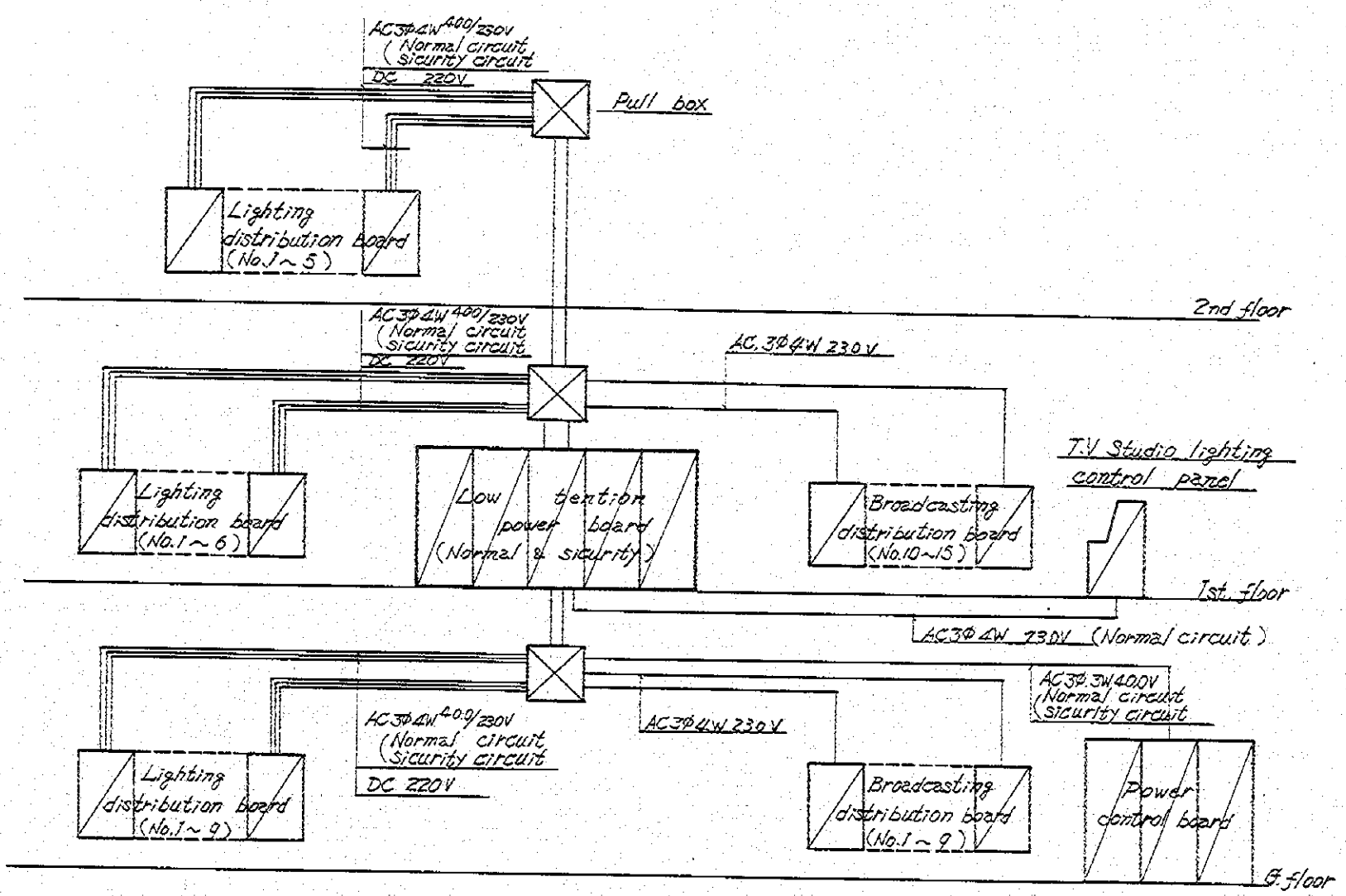


FIG. 2-6-4 POWER MAIN LINE SYSTEM

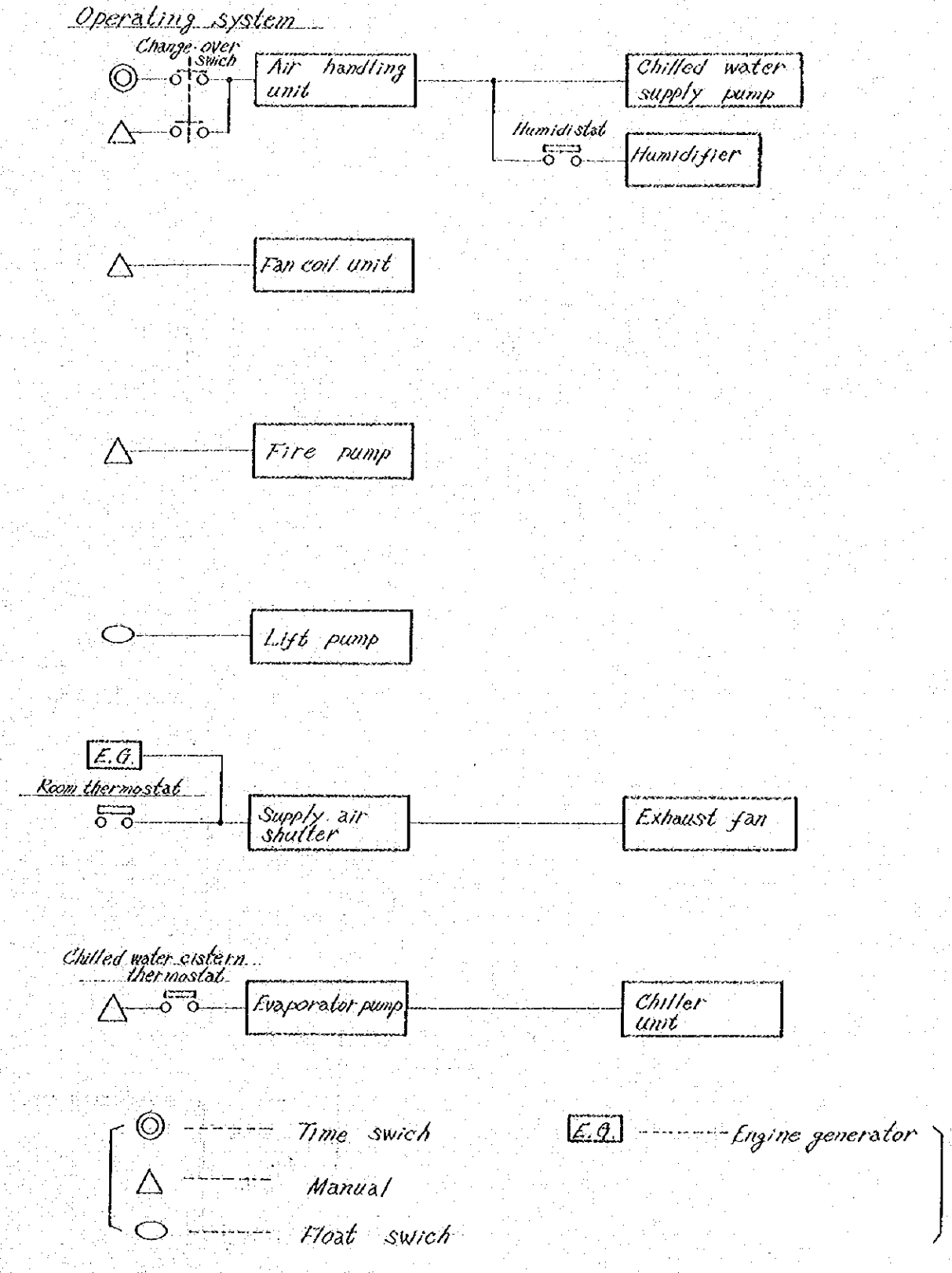


FIG. 2-6-5 MACHINE EQUIPMENT OPERATION SYSTEM

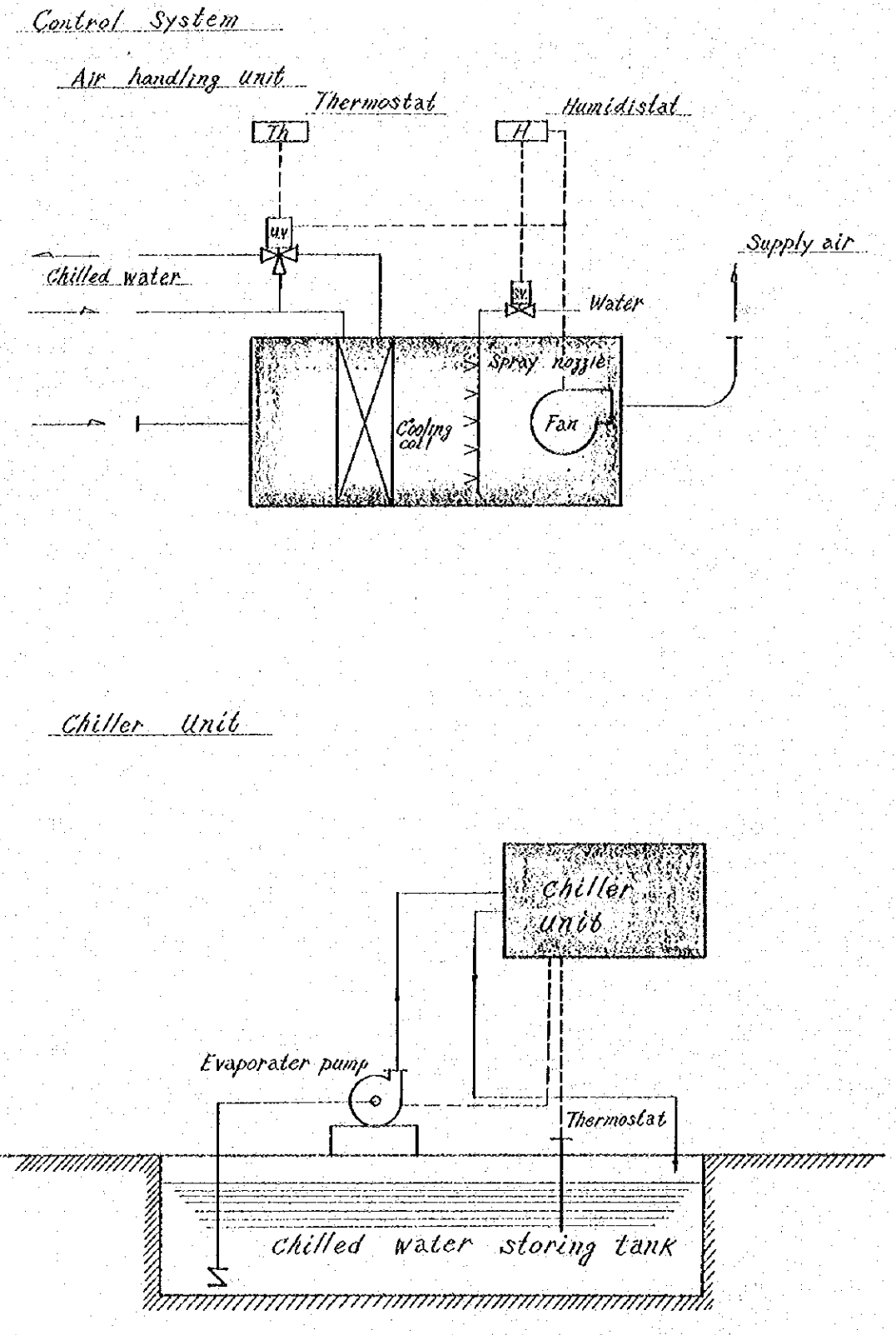


FIG. 2-6-6 MACHINE EQUIPMENT CONTROL SYSTEM

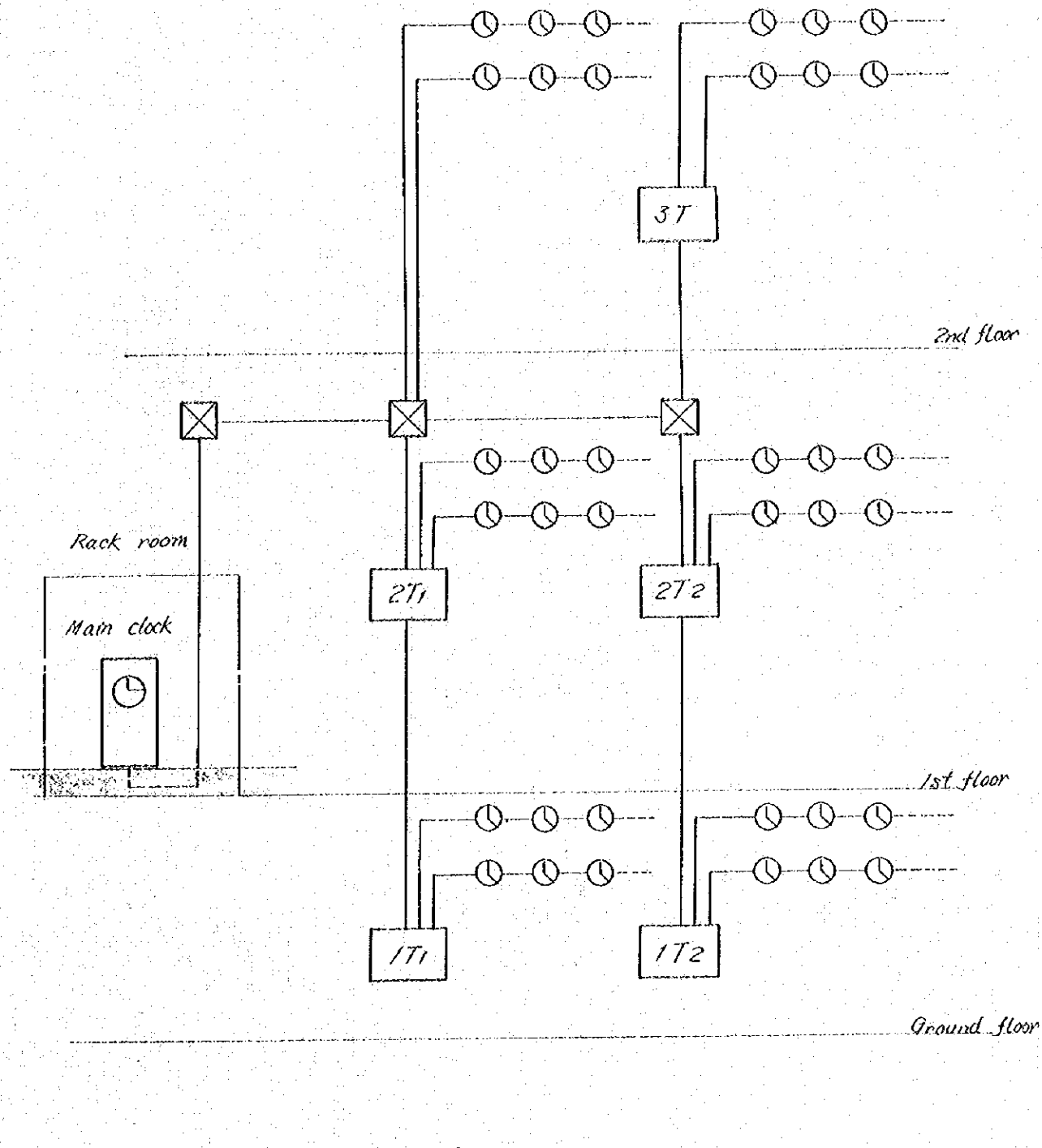


FIG. 2-6-7 CLOCK SYSTEM

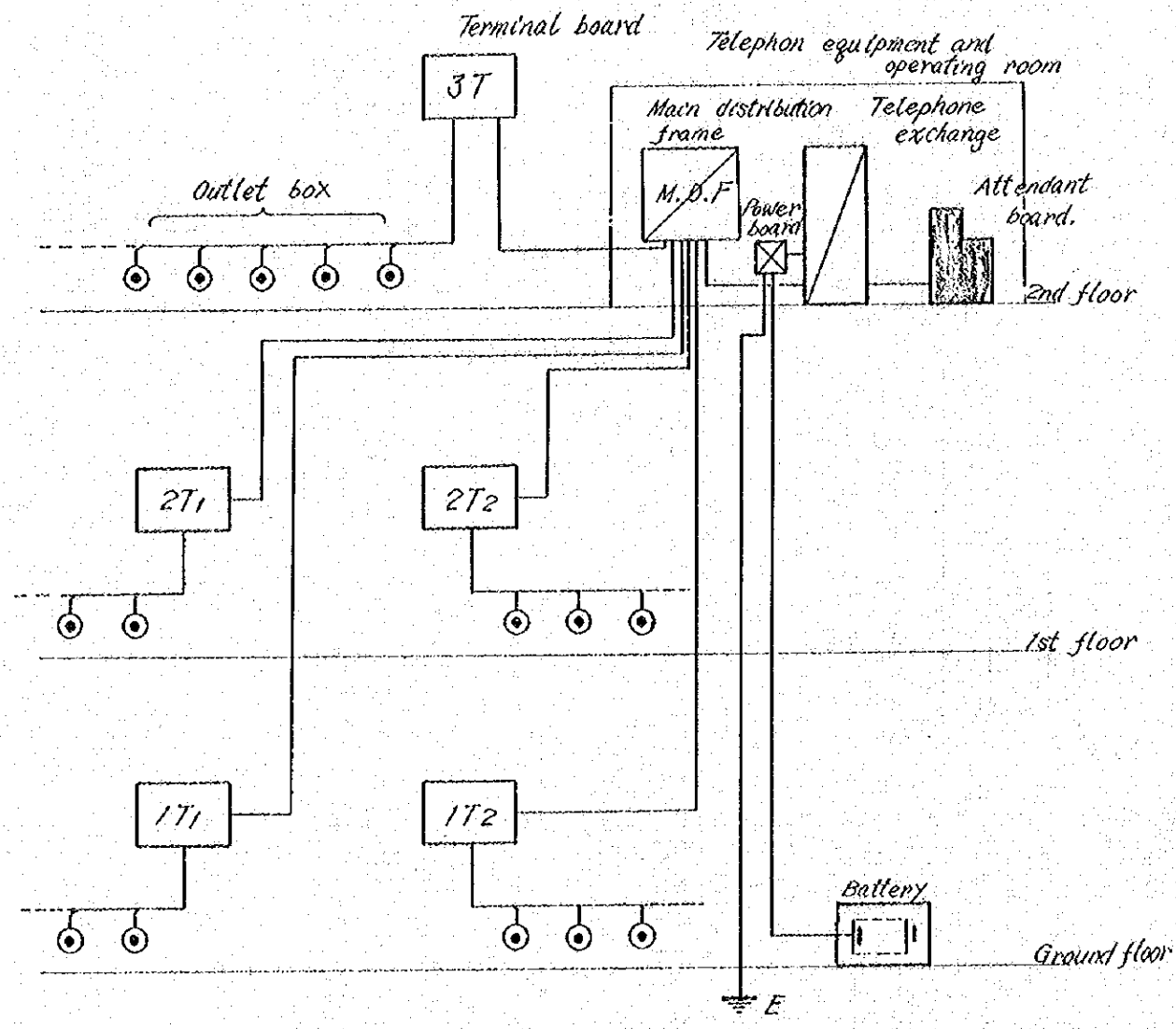
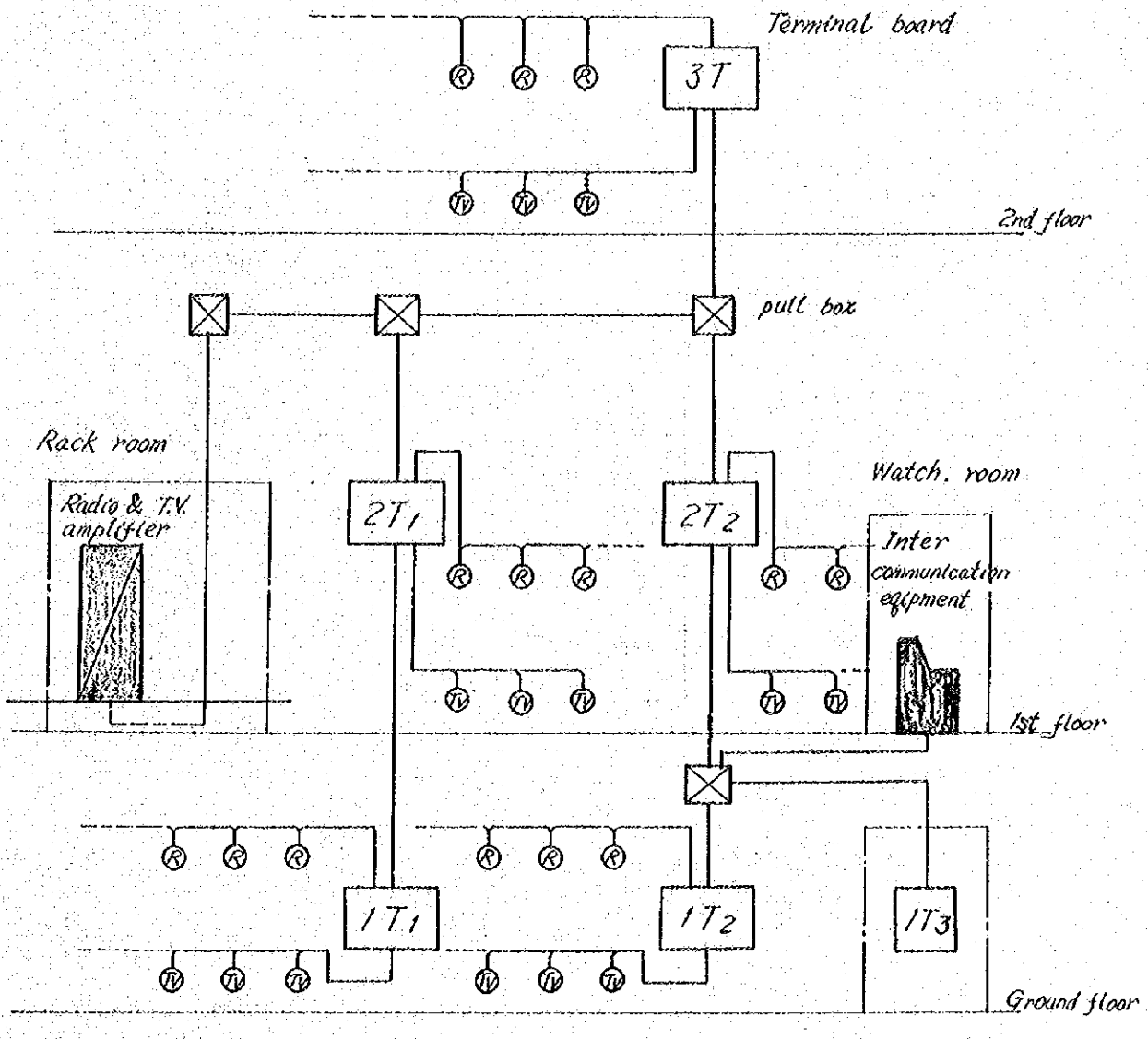


FIG. 2-6-8 TELEPHON SYSTEM



R ---------- Radio monitor speaker

TV ---------- Monitor T.V.

FIG. 2-6-9 RADIO & T.V. MONITOR SYSTEM

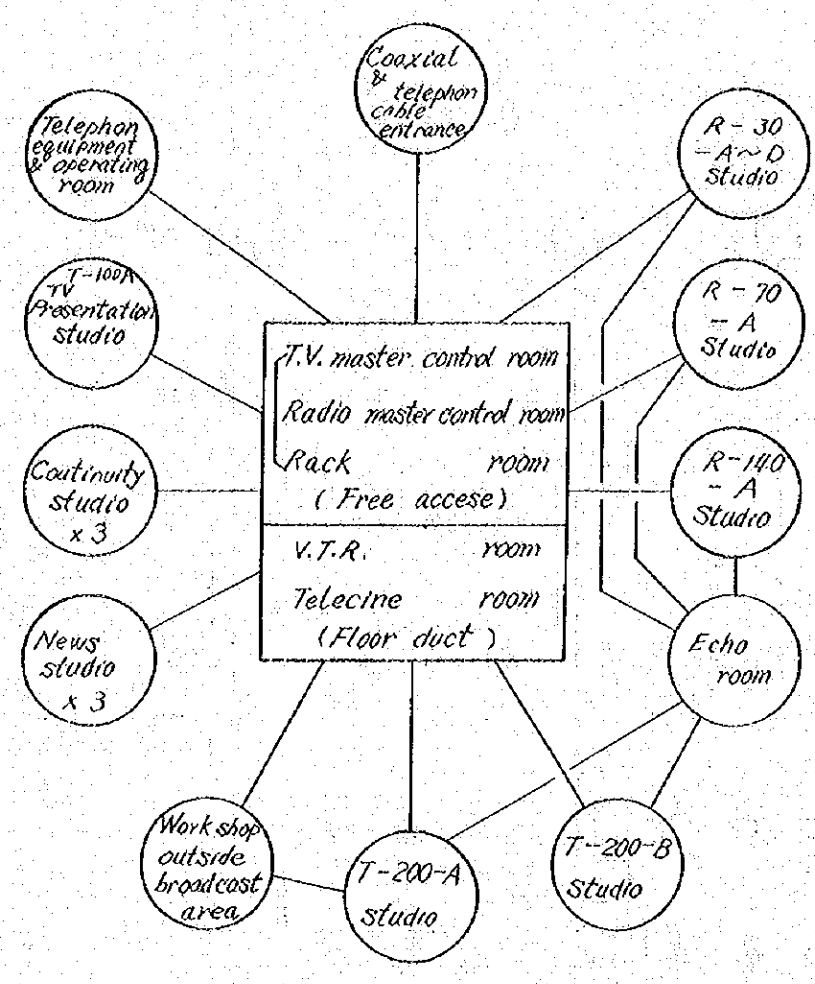


FIG. 2-6-10 PIPING SYSTEM FOR BROADCASTING APPARATUS

2.7 Acoustic Plan

2.7.1 Overall Plan

As the area surrounding the site is now considered relatively free of noise, no special problems are likely in the general arrangements against external noise. Sound insulation against external noise will be considered against the flight noise of helicopters (flying 100 meters above), and the radio studio will be designed for transmission loss of about 70dB at 500Hz while the television studio will be given a margin of about 60dB also at 500Hz.

The biggest noise source within the building is the standby generator. For this reason, it will be installed on the ground floor of the studio block closest to the office block so as to locate it as far away from the studios as possible in order to minimize the effect of the operating noise on the studios.

Parts of the air handling plant room will be adjacent to the studios as it has been unavoidable from design conditions, and sound insulation between the two rooms against airborne and solid-borne noise will require adequate care. With regard to the chiller unit to be installed on the roof, also, care will be needed for providing vibration isolation for the unit and the pipings connected to it, and for preventing the operating noise affecting the studios, control rooms and offices.

2.7.2 Room Acoustics

(1) Form and Dimensions

The form and dimensions of the room will be considered to avoid phenomena undesirable from the standpoint of sound recording and the hearing. For instance, form and dimensions will be considered to prevent "booming" arising from the lack of uniformity in the distribution of normal modes in the room, "flutter echo" arising from multiplexed reflections from two

parallel walls and sound concentration arising from concave surfaces.

1) Radio Studio (140m^2)

The walls and the ceiling will be composed of concave and convex surfaces to promote scattering of the sound. In order that the diffuser may be effective against frequencies above 80Hz, its dimensions will comprise 3 meters for the base and about 0.5 meters for the height.

The dimensions of the room will comprise those taken of averaged unevenness, and taking the ceiling height as 1, the ratio of the three sides will be aimed at 1 : 1.59 : 2.52.

2) Radio Studio (70m^2)

The walls and the ceiling will be composed of concave and convex surfaces to promote scattering of sound. The dimensions of the ceiling diffuser will be 2.2 meters for the base and 0.35 meters for the height so that it will be effective against frequencies above 100Hz. Sound scattering will be achieved by mounting box-like devices made of sound absorbent and reflective materials.

The dimensions of the room will comprise those taken of averaged unevenness, and taking the ceiling height as 1, the ratio of the three sides will be aimed at 1 : 1.59 : 2.52.

3) Radio Studio (30m^2, continuity and news studios, announce booth)

As this class is used as talk studios, the rooms are designed dead. For this reason, no two opposing walls are made parallel, the tilt being about 1/10. The ceiling and the floor are left parallel.

The dimensions of the room will aim at the ratio of 1 : 1.59 : 2.52, with the ceiling height taken as 1.

But, for news studios and announce booth, the dimension will aim at the ratio of 1 : 1.26 : 1.59, with the ceiling height taken as 2.4 meters.

4) Echo Room

The walls and the ceiling are inclined so that they will not be parallel to the opposing sides. The incline will be about 1/10.

The dimensions of the room will aim at the ratio of 1 : 1.59 : 2.52, with the ceiling height taken as 1.

5) Television Studios

As the scale is large, set-scene and lighting equipment are set up within and the room has to be designed sound absorbent, the shape will be rectangular.

The ceiling height required from television camera operation and the scale of the lighting equipment will be 9.5 meters in consideration of the curtain horizont height of 6 meters, grid height of 7 meters and the need for personnel to walk over the grid. The room dimensions will aim at the ratio of 1 : 1.26 : 1.59 with the ceiling height taken as 1.

6) Presentation Studio

Like the television studio, it will be rectangular in shape. The ceiling height required from tleevision camera operation and the scale of lighting equipment will be 5 meters, considering the grid height to be 4 meters. The room dimensions will aim at the ratio of 1 : 1.59 : 2.52 with the ceiling height taken as 1.

7) Rehearsal Rooms

Care will be taken so that the ratio of room dimensions will not become simple, such as 1 : 2 : 3.

(2) Reverberation Time and Interior Design

The optimum reverberation time and the frequency characteristics are shown in FIGS. 2.7.1 and 2. The reverberation time for each studio was determined on the basis of the purposes of use, room capacity and past experience.

1) Radio Studio ($140m^2$)

As this studio is to be used for musical programmes and dramatic programmes, arrangements will be made so that change of the reverberation time would be possible.

The method consists of hanging curtains over the three side walls and of hanging a curtain through the center of the studio so as to divide it into two parts.

The average absorption coefficient of the room without curtains would be about 25%, while the reverberation time would be about 0.8 second. When the curtains are hung over the three side walls, the average absorption coefficient of the same room becomes about 35% and the reverberation time, about 0.5 second. Although the average absorption coefficient of the room is about 25%, the room is divided into a live side and a dead side. The side where the entrance is provided would be the dead side.

Under the curtainless state, the frequency characteristics of the reverberation time will be suitable for music programmes. The floor will be covered with linoleum.

For the walls and the ceiling, the medium and high frequency absorbing material, low frequency absorbing material and reflective material will be combined appropriately to achieve the average absorption coefficient of 25%. Moreover, the materials will be distributed in such a manner that the absorption coefficient will gradually increase from the live side towards the dead side. With regard to the finish of the diffuser provided for the walls and the ceiling,

the same face will not be finished with the same material but the absorbing and reflective materials will be mixed so as to achieve better diffusive effect.

The curtains will be hung over the side facing the live side and the control room in order to achieve effective changes in the reverberation time. The studio can be divided into the live and dead sides by hanging a curtain at the center observation window of the room.

As the area of the observation window is large, the glass pane on the studio side is inclined so as to avoid multiplexed reflection with the opposing wall surface.

2) Radio Studio ($70m^2$)

Arrangements will be made to make the reverberation time variable, since this studio is to be used for chamber music, dramatic and lecture and interview programmes.

The method consists of hanging curtains over the three side-walls. The average absorption coefficient of the room without curtains will be about 25%, and the reverberation time will be about 0.55 second. With curtains hung over the three sides, the average absorption coefficient will become about 35% and the reverberation time, about 0.4 second or so.

The frequency characteristics of the reverberation time without the curtains will be for music programmes.

The floor will be covered with linoleum. Without providing the live and dead sides, the walls and the ceiling will be provided with evenly distributed medium and high frequency absorbing material, low frequency absorbing material and reflective material.

Curtains will be hung over the three walls other than the wall where the control room is located to vary the reverberation time. It will also be possible to create the

live side and the dead side by regulating the extent of curtain drawing.

As the area of the observation window is large, the glass pane on the studio side will be inclined to avoid multiplexed reflection with the opposing wall surface.

3) Radio Studio ($30m^2$, continuity and news studios, announce booth)

These studios are to be used for talk programmes, such as lectures, interviews, commentaries, disk jockeys, news and announcements. For this reason, the average absorption coefficient of the room will be set at about 35%. As to the reverberation time, it will be about 0.25 second or so for the $30m^2$ studios and the continuity studio and about 0.2 second for the news studio and the announce booth. The frequency characteristics of the reverberation time will be flat. The floor will be covered with linoleum.

The walls and the ceiling will be of checkered pattern with uniformly distributed medium and high frequency absorbing and low frequency absorbing materials.

4) Echo Room

The reverberation time desirable for the echo room is 3 seconds or longer. Flat frequency characteristic is considered preferable. Consequently, the floor, walls and the ceiling will be given hard finish as far as possible, and the reverberation time will aim at 3.5 seconds. If mortar and paint finish is considered for the floor, walls and the ceiling, the volume will be about $80m^3$.

5) Television Studios ($200m^2$ and presentation studios)

The average absorption coefficient will be as high as 40 to 50%. The reverberation time of the $200m^2$ studio will be about 0.45 to 0.6 second while that for the presentation

studio will be about 0.3 to 0.4 second.

While flat frequency characteristics of the reverberation time are desirable, that for 500Hz should not exceed 1.5 times, though some rise of the reverberation time in the low frequencies may be unavoidable.

The floor will be covered with linoleum. The floor should be finished as flat and smooth as possible in order to prevent screen oscillation while the camera is in motion.

The walls and the ceiling will be provided with medium and high frequency absorbing materials appropriately scattered.

6) Control Rooms

The average absorption coefficient of the room will be set at about 30% and the reverberation time, at about 0.3 to 0.4 second. Flat frequency characteristics of the reverberation time are desirable. For the walls and the ceiling, medium and high frequency absorbing and low frequency absorbing materials will be provided in an appropriately scattered form. Special care will be given to prevent the observation window from giving rise to multiplexed reflection with the opposing wall. For the ceiling, mineral fiber acoustical ceiling material will be used.

7) Master Control Room

On the wall facing the studio side medium and high frequency absorbing and low frequency absorbing materials will be used. For the ceiling, mineral fiber acoustical ceiling material will be used to make the room sound absorbent.

8) Rehearsal Rooms

Medium and high frequency and low frequency absorbing materials will be used for the two walls and the mineral

fiber acoustical ceiling material will be used for the ceiling, thus rendering the room sound absorbent.

9) Sound Locks

The sound lock of the studio will be finished as sound absorbent as possible. Between the sound lock and the corridor air escape will be provided. As the room is airtight in construction, there will be no escape for the air in the room when the door is being closed unless some escape is provided. Without this escape, therefore, difficulty will be experienced in closing the door. The air escape will be provided with necessary number of sound absorbent elbows so as to avoid impeding sound insulation between the corridor and the sound lock.

2.7.3 Noise Control

(1) Acceptable Noise Level

The acceptable level of standing meaningless noise like the airconditioner and ventilator buzz in the studio, control rooms and others and that of meaning noise, such as the talking voices in the corridor, music in the other rooms and outside traffic noise, are given in TABLE 2.7.1 and FIG. 2.7.3.

(2) Sound Insulation

1) Sound Insulation Required

Sound insulation required between rooms at 500Hz is given in TABLE 2.7.2. The sound insulation required was determined on the basis of the acceptable noise level in each room, the power level of the sound source, the area of the section requiring sound insulation, the sound absorption of the room and past experience.

2) Sound Insulating Construction

For the radio studios ($140m^2$, $70m^2$, $30m^2$, continuity, & news studios and announce booth) and the echo room, the floating construction will be adopted. The floating construction means that which is provided with sound insulation by resilient rubber mounting separating the inner structure from the main structure. As a result, the radio studios will be provided with double sound insulation, i.e., insulation by the building structure itself and by the vibration-proof sound insulating inner structure. This is a strict sound insulating structure against the air-borne and solid-borne sound. The natural frequency of this vibration-proof supporting system will be about 10Hz.

Something like precast concrete slabs should be considered for the floors of the $140m^2$ and $70m^2$ radio studios. Wooden floor will do for small talk studios like the $30m^2$ and smaller ones.

Television studios ($200m^2$ and presentation studios) will be of sound insulated construction depending largely on the structure of the building. Where special sound insulation is required, such as parts facing outside, the boundary between the air handling plant room and the boundary between the scenery store, will be provided with double wall with the inside wall built of bricks or concrete blocks some 20cm away from the building structure (posts and beams excluded). The ceiling will be provided with two layers of reinforced concrete slabs in order to insulate external noise.

For the stairways adjacent to the television studios, some means of preventing footsteps from coming into the studios will be necessary. On the presentation studio floor will be provided with a light concrete filling of about 15cm in thickness for concurrent use as space for electric piping.

Further, above the ceiling of the rehearsal room directly below the presentation studio will be provided a simple sound insulating layer in order to secure necessary insulation between the rehearsal room and the presentation studio.

As the sound insulating structure of the control room for shutting out outside noise, the walls will be of double construction like the television studios. Above the ceiling, a simple sound insulating layer will be provided.

3) Sound Insulating Doors and Observation Windows

Those going into and coming out of the studio will have to pass through the sound lock, which is provided for securing necessary sound insulation by the use of two doors. The door will be of steel made, with transmission loss of about 35dB at 500Hz. The door between the corridor and the sound lock will be mounted on the solid structure. The door between the sound lock and the studio, in the case of radio studio, will be mounted on the sound insulating structure of the floating construction. In the case of a television studio, the inner door will also be mounted on the solid structure. The door provided with a glass window will be convenient for the control room.

The set-scene portal for the television studio needs to be as wide and as high as 3m x 3.5m. If a double-wing door with required sound insulation is used, the weight will be considerable and opening-closing and maintenance will give much work. For this reason, two steel sound-proof shutters will be used. The space between the shutters will be about 1 meter, which will be given sound absorbent finish. The motor in the shutter driving gear will be given vibration-proof mount using a resilient rubber mounting. This will reduce transmission of solid-borne sound into the adjacent studio. The observation window between the radio

studio and the control room is composed of triple glass pane, with the framework divided into two. The framework with one glass pane on the studio side is mounted on the floating structure, and it will have the sound insulating capacity equal to that of the sound insulating layer of the floating structure. The observation window between the continuity and news studios and the master control room will be built in the same manner as in the case of the radio studio.

The observation window between the television studio and the control room will consist of double glass pane and be mounted on the solid structure. The observation window between the presentation studio and the master control room will be built in the same manner as that of the television studio.

(3) Noise Control of Airconditioning and Ventilating

In order that the acceptable noise level for each room given in TABLE 2.7.1 be satisfied, required sound insulation regarding noise from the airconditioners and ventilators that may affect the studios will have to be calculated and needed sound absorbing elbows and other measures will have to be provided at the implementation design stage. The outline of the measures and arrangement of the absorbent elbows will be considered in the following.

A studio will require six absorbent elbows from the airhandling plant to the supply and return opening. Firstly, three absorbent elbows will be provided for the airhandling plant room. This is intended to prevent noise from escaping outside the airhandling plant room by reducing, to some extent, noise generated by the airhandling plant within the air duct in order to lower the noise level of the air duct leading out of the airhandling plant room. Next, three absorbent elbows will be provided above the studio ceiling. These are intended to absorb noise generated

by the airhandling plant, while at the same time absorbing noise picked up from the corridor by which the air duct passes in its extension to the studio, as well as noise generated by the air current inside the duct, so as to prevent noise radiating into the studio. Directly above the supply and return opening will be provided a sound absorbent box without fail as the final absorbing device of any noise arising in the air duct.

Between the fan coil unit, which will be set up in the control room and others where the acceptable noise level is NC = 30 or below, and the supply and return opening at least one absorbent elbow will be provided.

For preventing noise arising from the air velocity in the air duct, the velocity will be limited to below 10m/sec. in the main duct, to below 7.5m/sec. in the branch duct and to below 4m/sec. in the terminal duct. The criteria for preventing generation of noise by the shape of the supply and return opening and the air velocity are as given in TABLE 2.7.3.

Adequate consideration should be given to cross-talk between two rooms via the air duct.

Parts of the wall of the radio studio ($70m^2$), television studio and presentation studio are adjacent to the airhandling plant room, and it must absolutely be avoided that the air duct to each studio from the airconditioner room should be led direct into the ceiling of the studio through the wall of the airconditioner room.

(4) Vibration-Proofing of Building Equipment, Air Duct and Water Piping

The standby generator, transformer, motor, pump, compressor, and blower to be provided for the studio block and equipment mounted with such units without vibration-proofing will all be installed with adequate vibration-proofing provided. The natural frequency of the vibration-proof supporting system

and the resilient material are as given in TABLE 2.7.4. The floors on which these equipment will be set up will be made as stout as possible.

Water pipes with a dimaeter of more than 32mm and air duct with its longer side or the diameter measuring more than 500mm will be suspended or propped up in the state of vibration-proof. However, water pipes and air ducts propped up on the ceiling, floor or the wall of the studio, control room and the building equipment room will all be of vibration-proof suspension or vibration-proof supporting. The natural frequency of the vibration-proof supports will be 10Hz or below.

Water piping, air duct and electric wire pipes to be connected with rotary equipment will be done so by means of flexible joint.

Where the vibration-proofed water pipe or air duct passes through a solid structure, vibration-proofing will be provided. For the air duct that passes through the solid structure of the studio, a flexible joint will be provided on the studio side.

Electric wire piping into the studio or the echo room with floating construction will be provided with flexible joint where it passes through the solid structure of the studio.

2.7.4 Acoustic Processing in Other Rooms

(1) Garage

As the garage is located near the television studios, 50dB or higher (transmission loss at 500Hz) sound insulation capacity will be given to the garage walls so that engine noise in the garage will not be heard in the studios.

(2) Standby Generator Room

As noise arising from the generator, in case the standby generator is operated, is quite big, it will be necessary to consider sound insulation aimed at preventing this noise affecting

other rooms, particularly the studios and control rooms. For noise leak from the air intake or the exhaust outlet, in particular, considerations, such as providing sound absorbent chamber, will be necessary.

Sound-proof doors with air-tight fit must also be used. It is also desirable to make the room sound absorbent.

As the generator is a very high-power rotary device, adequate vibration-proofing will be provided in order to minimize solidborne noise.

(3) Building Equipment Room

Air-tight and sound-proof doors will be used for the building equipment rooms so that the operating noise inside the rooms will not leak outside like the corridor. It is also desirable to provide sound absorbents for the rooms.

TABLE 2.7.1 ACCEPTABLE NOISE LEVEL IN ROOMS

Room	Acceptable noise level	
	Meaningless noise	Meaning noise
Radio studio ($140m^2$ & $70m^2$)	NC-20	M'-20
Radio studio ($30m^2$)	NC-15	M'-15
Continuity & News studio Announce booth	NC 15	M'-15
Television studio ($200m^2$)	NC-20	M'-20
Presentation studio	NC-20	M'-20
Control room	NC-25	
Master control room	NC-30	
Rehearsal room	NC-30	
Conference room	NC-30	
Office room	NC-35	

TABLE 2.7.2 SOUND INSULATION REQUIRED BETWEEN ADJACENT ROOMS

Adjacent rooms		Transmission loss at 500Hz
Radio studio	- Outdoors	70dB
Radio studio	- Rehearsal room	65dB
Radio studio	- Lobby	65dB
Continuity studio	- News studio	65dB
News studio	- Master control room	65dB
News studio	- Outdoors	70dB
Television studio	- Outdoors	60dB
Television studio	- Carpenter shop	60dB
Television studio	- Lobby	50dB
Television studio	- Control room of other studio	60dB
Television studio	- Air handling plant room	50dB
Presentation studio	- Master control room	50dB
Presentation studio	- Lobby	55dB
Presentation studio	- Rehearsal room	65dB
Presentation studio	- Outdoors	60dB
Control room	- Lobby	50dB
Control room	- Outdoors	60dB

TABLE 2.7.3 MAXIMUM ALLOWABLE AIR VELOCITY AT A NECK OF OPENING

Room	Type of Supply opening	Maximum air velocity
News studio & Announce booth	Pan-Type	1 m/sec
Continuity & Radio studio	Anemostat on Pan-Type	1.8
Radio studio ($140m^2$)	Nozzle-Type	2.5
Television & Presentation studio	Nozzle-Type	3.0
Control room	Anemostat	3.0
Office room	Anemostat, Grille, etc.	4.0

Return opening: Grille is applied in all rooms.

TABLE 2.7.4 VIBRATION ISOLATION OF MACHINERY

Machinery	Natural frequency of Oscillation	Resilient material
Machine speeds over 1200 r.p.m.	less than 600 c.p.m.	Synthetic rubber
Machine speeds up to 1200 r.p.m.	less than r.p.m. x 1/2	Synthetic rubber or Coiled spring

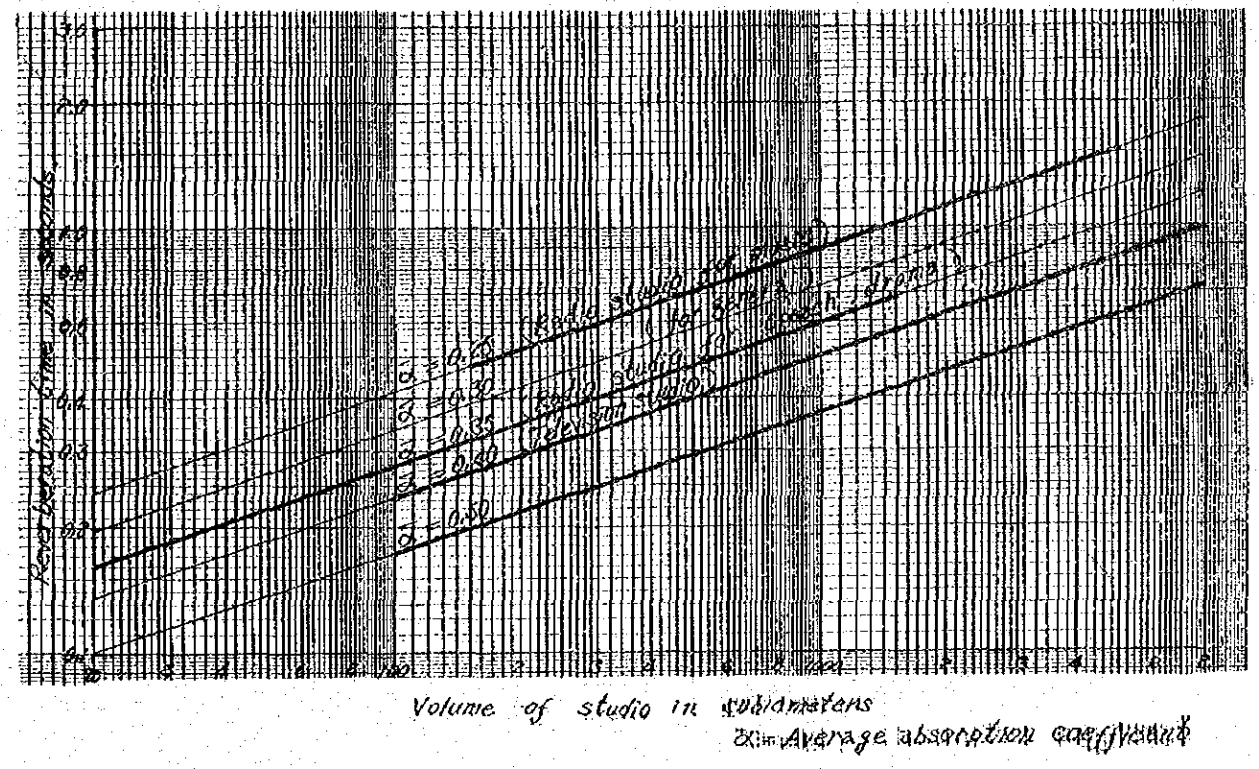


FIG. 2-7-1 OPTIMUM REVERBERATION TIME AS A FUNCTION OF STUDIO VOLUME AND THE AVERAGE ABSORPTION COEFFICIENT

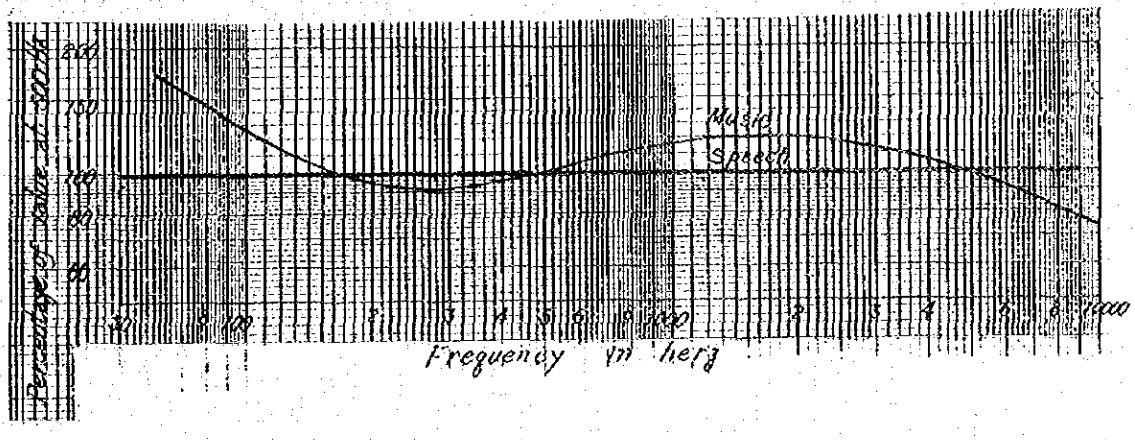


FIG. 2-7-2 OPTIMUM REVERBERATION TIME AS A FUNCTION OF FREQUENCY

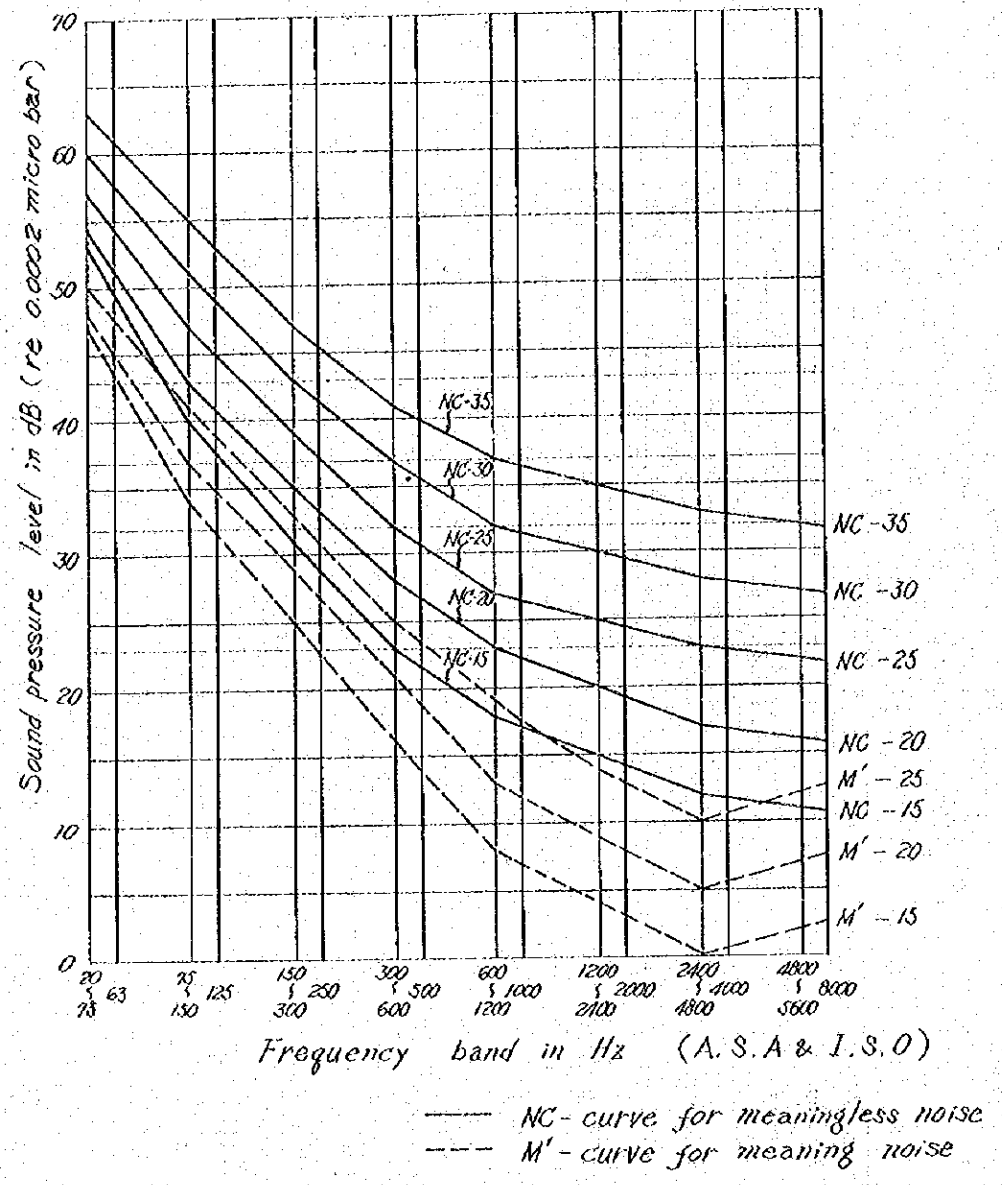


FIG. 2-7-3 ACCEPTABLE NOISE LEVEL FOR MEANINGLESS NOISE AND MEANING NOISE

Chapter 3. TV Transmitting Station

The following seven transmitting stations will be constructed in accordance with the station establishment plan.

Station	Transmitter output
Kasompe	10kW x 2
Nakupata Hill	"
Kabwe	"
Lusaka	"
Pemba	"
Tara	1kW x 2
Senkobo	10kW x 2

3.1 Sites

Kabwe: In the compound of the existing radio transmitting station.

Pemba: An approximately level site adjacent to the microwave relay facilities.
The site is expected to be 70m x 70m in area, including the site for the facilities.

Senkobo: Same as above.

Kasonpe: A public water supply facilities is found nearby, and construction of a housing complex near the site seems to be under consideration.

Regarding the sites for the four other transmitting stations, including the Kasonpe Station, the exact locations of the sites at the place under consideration are yet to be determined.

For the elevations, access roads and power supply routes, etc. of the seven places, see pertinent data on the station establishment plan included in Vol. I Basic Plan.

3.2 Arrangement of Building

With respect to Kabwe, the location will be determined in consideration of the location of the existing radio transmitting tower and of the anchors for the guys.

Incidentally, in consideration of possible effect of radio wave, the television transmitting station building and the tower will be located as far away from the radio facilities as possible.

In Senkobo the location of the guyed steel tower will be determined on the basis of the location of the guy wire anchors within the site.

The area of the Pemba site is large enough to erect the guyed steel tower. However, the self-supporting steel tower will be adopted instead of the guyed type, since the tower will have to be built close to the microwave route. The station building and the steel tower will be arranged so as to minimize the site area.

While concrete arrangements within the sites at four other places will have to wait for selection of the sites themselves, concrete arrangements will have to be made in consideration of the conditions of locations and the most suitable steel tower system between the guyed and self-supporting types.

3.3 Construction Plan

3.3.1 Planning

The station building design will be common to all the seven sites, but with respect to the Kabwe Transmitting Station, it will be necessary to consider peripheral shielding for the transmitter room in consideration of possible effect of radio wave.

The station building will comprise the transmitter room, power receiving room, office and workshop, etc. For the transmitter room, some space for setting up an FM transmitter in the future will be reserved.

In the power receiving room, the bed for the standby generator will be provided. For both rooms floor ducts for inter-equipment connections will be provided.

Forced exhaust will be provided for the transmitter and power receiving rooms in order to prevent temperature rise, and for assuring the effect thereof air chambers will be provided around the air intake and outlet.

An underground oil tank for the standby generator will be built outdoors.

As the transmitting station is unattended, some protective measures for the entire facilities would have to be considered.

3.3.2 Required Rooms and Areas

The required rooms and their areas will be given in TABLE 3.3.1.

3.3.3 Finishes

External and internal finish will be given in TABLE 3.3.2.

Around the site will be erected a fence about 2 meters in height and a gateway will be provided. The entire site will be levelled out and covered with ballast.

Addenda:

As for the followings, the same measures should be taken for the TV transmitting stations as the Studio Centre.

* Protection against infestation by termite and other vermins.
* Heat insulating layer.

TABLE 3, 3, 1 SCHEDULE OF ACCOMMODATION FOR TELEVISION TRANSMITTING STATION

Transmitter room	85 m^2
Power receiving and standby generator room	55
Office	12
Rest room	12
Workshop	16
Others	28

TABLE 3, 3, 2 ROUGH SCHEDULE OF FINISHES FOR TELEVISION TRANSMITTING STATION

External finish			
	Roof		Sanded asphalt waterproofing, reflective painting
	Eaves		Waterproof cement mortal plastering
	Wall		Waterproof cement mortal spray coating
	Door, Window		Steel, painting
Internal finish			
	Transmitter room Power receiving and standby generator room Office Rest room Workshop	Floor	P. V. C. floor tiling
		Wall	Cement mortal plastering, painting
		Ceiling	Cemented excelsior boarding, painting
	W. C.	F	Clay tiling
		W	Clay tiling
		C	Cemented excelsior boarding, painting
	Air chamber	F	Cement mortal plastering
		W	Concrete block
		C	Cemented excelsior boarding

3.4 Structural Plan

All seven transmitting stations will be of the same design. Data obtained by survey of the ground conditions for the foundation of the steel tower will be good enough for the building. Both the outer walls and the room partition walls of the building will be of hollow concrete block construction. The roof and the foundation will be of reinforced-concrete construction. The concrete floor will be of the single arranging bar type. The foundation for the standby generator will be plain concrete construction.

3.5 Ventilation and Oil Supply Equipment Plan

(1) Ventilation Equipment

Cooling by forced ventilation will be adopted for the TV transmitter and power receiving rooms, since the transmitting equipment generate considerable heat.

Natural ventilation through open windows will be adopted for the office, workshop and rest room. Inforced ventilation, fans will be used to discharge the room air outside. The air from outside will be allowed to flow naturally into the rooms through air intake ports provided at appropriate spots.

The exhaust fans will be provided in scattered arrangement in consideration of the flow of air in the rooms. Air filters of synthetic resin material, which can be washed and used over and over again, will be provided at the air intake ports.

The indoor air exhaust fans will operate under command of thermostats. The acceptable indoor temperature will be 40°C, while the designed outdoor temperature will be the monthly average of the highest temperature of a day prevalent in the region.

For the TV transmitter room, the size of the air intake port will be determined so that no interference will take place between the pressure fan self-contained in the transmitter and the indoor air exhaust fan.

An air duct will be connected to the upper part of the transmitter to discharge the inside air directly outdoors. In case of the shortage of static pressure for the pressure fan in the transmitter, a booster fan will be provided.

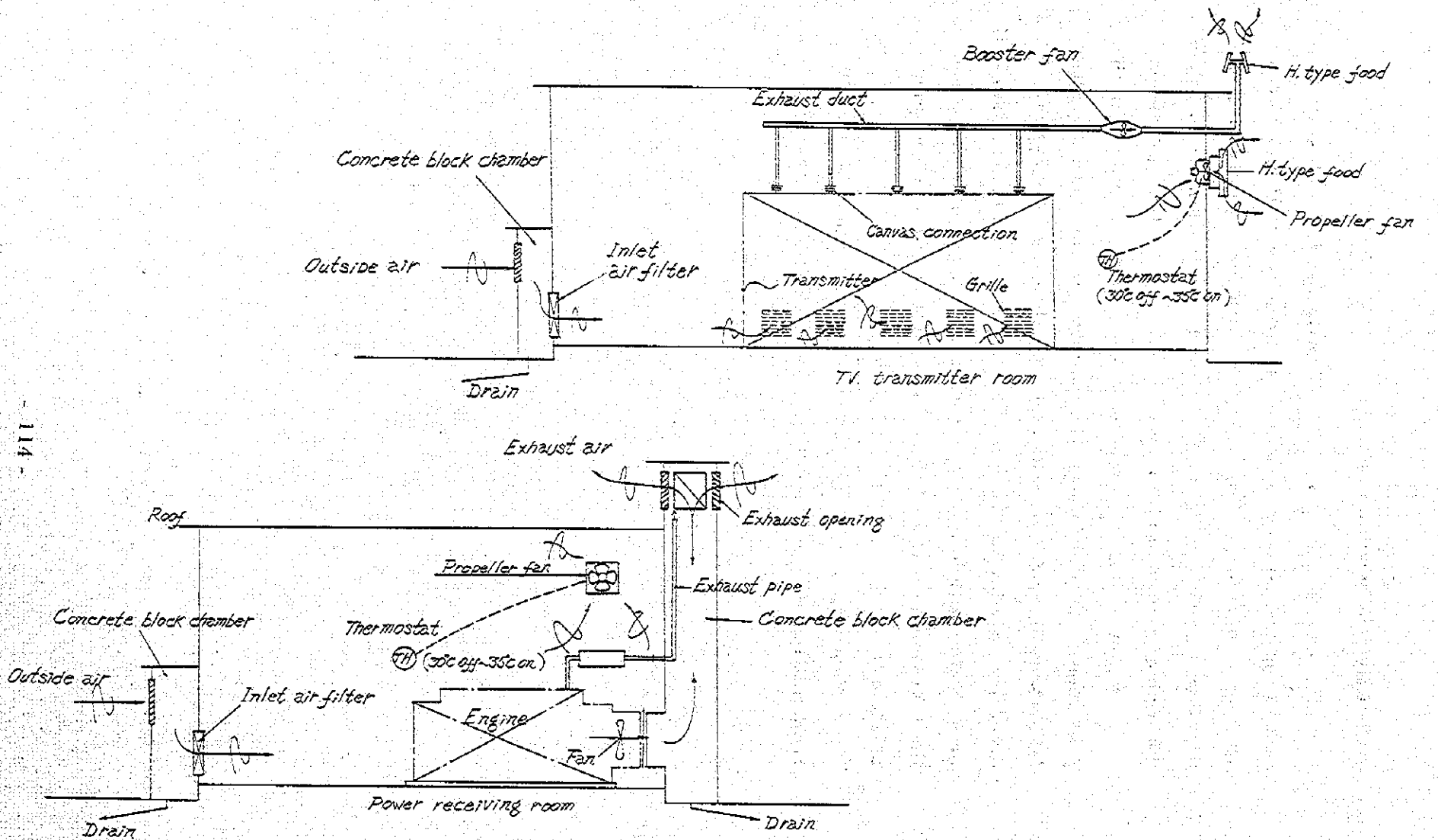
In the power receiving room, the exhaust fan will be interlocked with the engine so that it will stop when the engine starts. The exhaust fan will be set so that it goes ON at 35°C and OFF at 30°C.

(2) Oil Supply Equipment and Others

As standby generator will be installed for each station as part of the transmitter equipments, provision will be made for oil supply therefor. The main tank with the capacity of 2,000 liters will be built underground outside the building, and connecting piping from it to the indoor service tank will be provided.

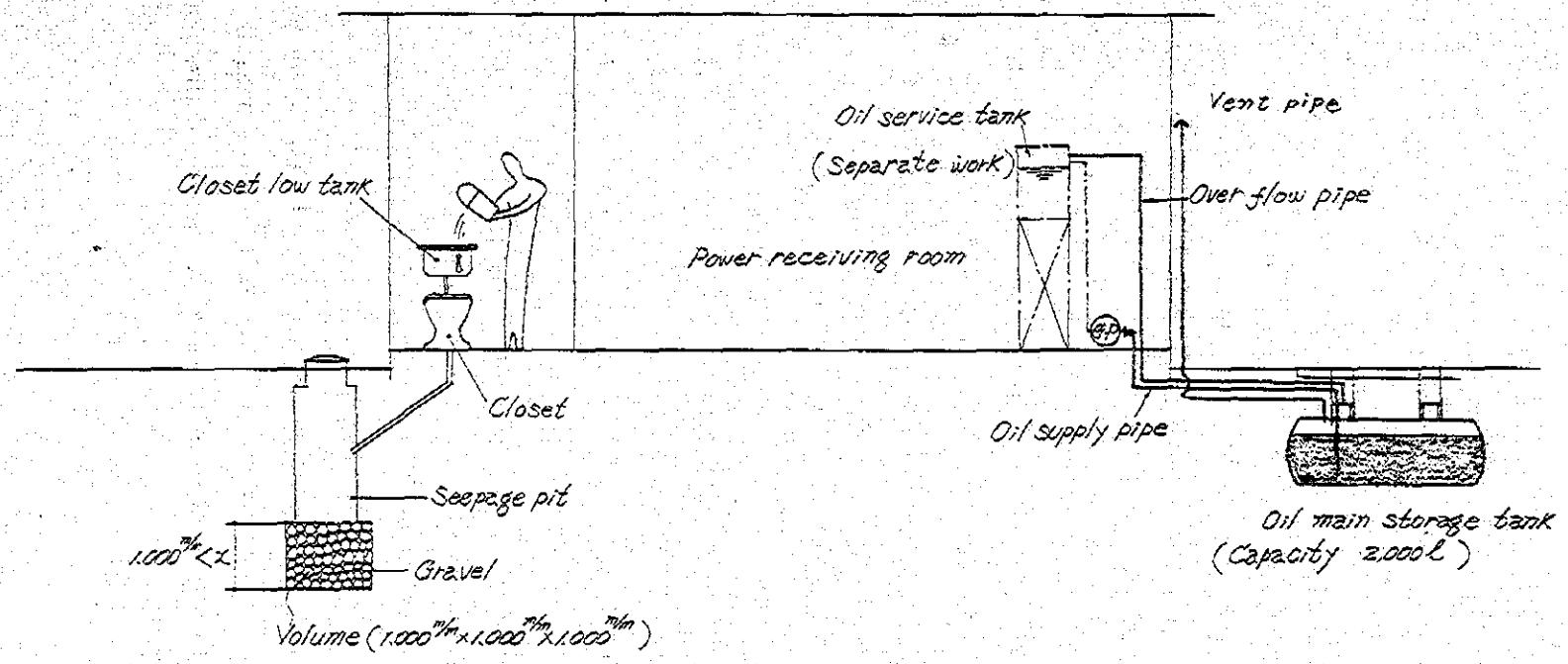
A sink will be provided with appropriate plumbing in the rest room. Toilet flush will be allowed to flow into the filter framework provided outside. If no public water supply is directly available for washing the closet, maintenance man will bring water with him at the time of periodical maintenance of the transmitter and so forth, and supply it into the low tank, and use it.

Ventilation, oil supply and other equipment for the TV transmitting station are outlined in FIGS. 3-5-1 and 3-5-2.



VHF TV TRANSMITTING STATION

FIG. 3-5-1 ELEVATION VIEWS OF VENTILATOR



VHF TV TRANSMITTING STATION

FIG. 3-5-2 ELEVATION VIEWS OF PLUMBING EQUIPMENT

3.6 Electric Installation Plan

A lighting distribution board and a power board will be installed for use as power source for electric lights, plug sockets and exhaust fans. These boards will be supplied with power from the power supply panel to be installed as part of the transmitter equipments.

Lighting of 250 Lx will be provided for the transmitter room, the office and workshop, 200 Lx for the power receiving room and 150 Lx for all other rooms. The plug sockets will be provided at the rate of two per each room. Both the electric lights and plug sockets will be supplied with 230V (power supply plug socket for taking measurements of the transmitter will be prepared together with the transmitter equipments).

The exhaust fans in the transmitter room operate by thermostat or by hand. The exhaust fans in the power receiving room will also operate by thermostat and by hand, but arrangements will be made so that the fans will stop when the generator starts.

The transmitter cable routes will be provided in accordance with the requirements of the transmitter equipments.

The aviation obstruction lights, which will be of automatic blinking type, will be mounted on the tower in accordance with regulations. The earths will comprise the one for the transmitter and the other for the lightning conductor. In either case, jointed type copper rods will be driven into the ground and these will be connected with copper wires in a net form. If it should prove difficult to drive copper rods of required length into the ground, the number of places where copper rods are driven in will be increased.

Automatic fire alarms will be installed inside the building in accordance with regulations. In case of fire, the alarm will be sounded at the Studio Centre in Lusaka in charge of the transmitting station in question.

Chapter 4. Steel Tower

4.1 Overall Plan

As has been stated in Vol. I Basic Plan, both the self-supporting tower and the guyed tower have specific features. In this plan, the towers have been selected on the basis of the features best suited to the conditions found at various sites.

4.1.1 Television Tower

With regard to television towers, the heights and the type have been selected as given in TABLE 4.1 on the basis of conditions related to the sites and existing facilities, ratings of the antennas and the like and whether or not S.T. link antennas exist under the coverage planning. The towers are outlined in Drawing, T.V. TOWER & STUDIO CENTRE TOWER, while the locations at the sites are given in Drawing, T.V. TRANSMITTING STATION.

In the following, brief descriptions will be presented with respect to various stations.

1) The self-supporting tower has been selected for Kasompe, Nakupata Hill and Lusaka as S.T. link antennas are used at these places. Locations within the sites will have to wait till concrete surveys are taken.

2) The self-supporting tower has been adopted also for Tara. If the conditions at the site are feasible to a guyed type, a guyed tower will do just as well.

3) As the site, where the radio station is already in operation, is to be used at Kabwe, it will be necessary to remove the TV tower as far away from the radio antenna as possible. It will also be necessary to avoid absorption of medium wave by the guy wires. From the above reasons, the self-supporting type has been selected for Kabwe.

4) The guyed tower has been selected for Senkobo as the site is large and no S.T.L. antenna is needed because of the existence of microwave terminal within the site. However, it will be necessary to avoid the existing microwave route and erect the tower as far away from the route as possible.

5) At Pemba, the site is large and no S.T.L. antenna is needed as a microwave terminal is found within the site. However, the self-supporting tower has been selected for this place as the guyed tower will have to be built too close to the existing microwave route.

4.1.2 Studio Centre Tower

A self-supporting tower 25 meters in height for microwave and S.T.L. antennas will be erected on the roof of the Lusaka Studio Centre. This tower is outlined in Drawing, T.V. TOWER & STUDIO CENTRE TOWER.

4.2 Tower Structure and Others

4.2.1 Self-supporting Tower

(1) Foundation

It will be of reinforced-concrete construction. It will be of type and dimensions suitable for the ground condition of the site. It will be of build that will adequately withstand not only its own weight but also compression by wind pressure, tension and horizontal force. Anchor bolts will be buried in the foundation, and these will be coupled with the tower base plate.

(2) Tower

It will be of truss structure using steel angles or steel pipes and will have strength and stiffness withstanding not only its self-weight but also the wind pressure load, temporary stress at the time of erection. Bolt jointing will be adopted for field jointing.

(3) Attached Equipment

The tower will be provided with a ladder, landing, feeder rack, parabola mounting and aviation obstruction lights. Also, arrangement will be made for allowing plug-in mounting of the U.H.F. antenna post in the future.

4.2.2 Guyed Tower

(1) Mast Foundation

It will be of reinforced-concrete construction. It will be of form and dimensions best suited to the ground conditions of the site and will be stout enough to withstand not only its self-weight but also compression due to wind pressure and horizontal force. For the foundation, anchor bolts will be buried to which the post base will be coupled in a state close to pin jointing.

(2) Anchor Block

It will be of reinforced-concrete construction. It will be of form and dimensions that will be sufficiently safe since it will resist the initial tension of the supporting wires and the maximum tension of the wind pressure load with its self-weight the frontal soil pressure and the base frictional force. Also, a steel frame will be buried into the anchor block to couple the turn buckle of the guy end with it.

(3) Mast

It will be of built-up column using steel angles and steel pipes. It will be provided with strength and stiffness sufficient to withstand its own weight, compression force arising from the initial tension of the guy and wind pressure load to the guy, the bending moment and shearing force. The guy mount will be of rigid construction that will transmit the force from the guy smoothly to the mast. Field assembly will be made with bolt jointing.

(4) Guy

Hot-dipped zinc-coated steel wire strands with tensile stress of 150 kg/mm^2 will be used. The two ends will be provided with sockets made of pure zinc. The tower end is mounted on the tower proper with the right-angle clevis, while the anchor side is mounted on the anchor with turn buckle. The initial tension of the guy is determined at a level that will not give rise to any tilt or twist harmful to the mast and antenna, feeder, etc. at the time wind pressure load is imposed.

(5) Attached Equipment

The mast will be provided with a ladder, landing, feeder rack and aviation obstruction lights. Also, arrangements will be made for allowing plug-in mounting of the U.H.F. antenna post in the future.

4.2.3 Rust-proofing

(1) Zincification

Hot-dipped zinc coating will be given to all steel material except parts buried in concrete.

(2) Coating

Three coatings of paint will given the tower. White and red finish, which is the day time mark for air traffic obstruction, will be given.

4.2.4 Attached Electric Equipment

(1) Earth

For the tower earth, twisted copper wire is buried underground into the 2.5-meter grid and the copper rods, driven into the crossing points, are connected to the grid. The net form earth and the driven earth rod are concurrently used. The earth resistance is to be 10Ω or below.

(2) Aviation Obstruction Light

As aviation obstruction marks, obstruction lights are installed at the top of the tower and along the tower between the ground and the top at a certain spacing. Specifications of the light and the mounting locations will be in accordance with the regulations of the Republic of Zambia, or International Civil Aviation Organization Standards.

4.3 Antenna and Related Equipment

4.3.1 Antenna

The antenna to be mounted on the tower is outlined in TABLES 4.2 and 4.3. The tower should have sufficient strength with the aforementioned antenna mounted on it. It will also be of construction feasible to antenna mounting.

4.3.2 Horizontal Ladder for Power Supply Line

A horizontal ladder of steel make will be provided between the power supply line outlet of the transmitting station and the studio centre master control room to the vertical tower feeder rack. A cover will be provided for the horizontal ladder to protect the power supply line.

4.4 Basic Conditions for Implementation Design

4.4.1 Design Conditions

Basic conditions necessary for implementation design are as follows:

(1) Wind Pressure Load

With regard to the wind velocity, the "Meteorological Notes Serles A, No.5 Extreme Winds in Zambia" (published by the Department of Meteorology in the Republic of Zambia) was used as reference to obtain the following velocity pressure at Vo = 45m/sec. at the height of 10 meters from the ground surface:

Wind velocity at Z-meter height:

$$V_{(z)} = Vo \times (\frac{Z}{10})^{\frac{1}{7}} \quad (m/sec) \quad \cdots\cdots\cdots \text{ equation (1)}$$

Velocity pressure at Z-meter height:

$$q_{(z)} = V^2(z) \times \frac{1}{16} \quad (kg/m^2) \quad \cdots\cdots\cdots \text{ equation (2)}$$

Substituting equation (1) for equation (2)

$$q_{(z)} = 127 \times (\frac{Z}{10})^{\frac{2}{7}} \fallingdotseq 127 \times (\frac{Z}{10})^{\frac{2}{8}} \quad \cdots \text{ equation (3)}$$

Therefore:

$$q_{(z)} = 127 \times \sqrt[4]{\frac{Z}{10}}$$

Regarding the wind force coefficient, the standard for structure design of steel tower provided by the Architectural Institute of Japan is followed.

(2) Tower Flexion at Wind Pressure Load

The tilt angle and twist angle of the tower at the S.T.L. antenna mounting position should be within 40 minutes at the time the maximum wind pressure load is imposed.

(3) Specifications and Allowable Unit Stress of Materials Used

Specifications of materials used will conform to JIS (Japan Industrial Standards). The allowable unit stress of the materials used will conform to the Building Standard Law Enforcement Ordinance of Japan, the Standard for Structure Design of Steel, the Standard for Structure Design of Steel Tower and the Standard for Structure Design of Reinforced Concrete, established by AIJ (Architectural Institute of Japan).

(4) Consideration Given to Future Erection of Additional Antennas

The strength and structure of the tower will be such that UHF and FM antennas can be mounted in the future.

4.4.2 Investigation Items

(1) Allowable Bearing Power of Soil

Prior to drafting the implementation design, surveys will be made of the ground foundation of the construction sites to determine the allowable bearing power of soil.

(2) Parabolic Antenna Direction

The direction of the parabolic antenna to be mounted on the tower will be surveyed in advance at each construction site and then design of the parabola mounting frame will be executed.

TABLE 4.1 TOWER HEIGHT AND TOWER TYPE

Station	Tower height	Tower type
Kasompe	60 m	S
Nakupata Hill	60	S
Kabwe	60	S
Lusaka	100	S
Pemba	60	S
Tara	60	S or G
Senkobo	60	G

Note: S: Self supporting tower G: Guyed tower

TABLE 4.2 OUTLINE OF ANTENNA

Station	T.V. Antenna		S.T.L.-Antenna	Future - Antenna	
				UHF-TV	FM
Kasompe	2D-OD	7 Stage 4 Bay	1-3Mϕ Para 2-Yagi	Band IV/V -Ant	FM-Ant
Nakupata Hill	2D-D	6, 3 Stage 1 Bay	1-1.8Mϕ Para 2-Yagi	"	"
Kabwe	2D-OD	7 Stage 4 Bay	—	"	"
Lusaka	2D-OD	7 Stage 4 Bay	1-1.8Mϕ Para 2-Yagi	"	"
Pemba	2D-OD	7 Stage 4 Bay	—	"	"
Tara	2D-OD	4 Stage 4 Bay	—	"	"
Senkobo	2D-OD	7 Stage 4 Bay	—	"	"

Note: 2D: 2-Dipole panel antenna
OD: Omnidirectional
D : Directional
Para: Parabola antenna
Yagi: Yagi antenna

TABLE 4.3 STUDIO CENTRE ANTENNA

	STL-Antenna	Future-Antenna
Lusaka Studio Centre	3-1.8Mϕ Para 4-Yagi	1-3.0Mϕ Para

PART 2

DRAWINGS

LIST

1	STUDIO CENTRE	SITE LOCATION PLAN
2	STUDIO CENTRE	SITE PLAN
3	STUDIO CENTRE	GROUND FLOOR PLAN
4	STUDIO CENTRE	1ST FLOOR PLAN
5	STUDIO CENTRE	2ND FLOOR PLAN
6	STUDIO CENTRE	ELEVATION SOUTH-WEST
7	STUDIO CENTRE	ELEVATION NORTH-EAST
8	STUDIO CENTRE	SECTION
9	T.V. TRANSMITTING STATION	
10	T.V. TOWER & STUDIO CENTRE TOWER	