ENGINEERING GUIDE
FOR
VENTILATING AND AIR-CONDITIONING
DESIGN PARAMETERS AND GENERAL PLANNING INFORMATION

CONTENTS PAGE

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CONTENTS PAGE

Tables

1. GENERAL

1.01 This section discusses design parameters and information for use in the design of environmental control or Heating, Ventilating, and Air-Conditioning (HVAC) systems. The parameters and information are provided for use in the planning and design of new buildings, building additions, and buildings that are intended to house telephone equipment that meets the requirements of Section 800-610-164.

1.02 Due to the level and scope of changes to this section, change arrows have been omitted from this issue. This section is being reissued to:

(a) Update the design parameters for new mechanical systems in conformance with Bell System Energy Conservation programs.

(b) Supersede the mechanical design criteria outlined in System Letter GL 74-01-155.

(c) Supersede System Letter SR 80-09-019 with the inclusion of wideband temperature operation.

(d) Eliminate nomographs for preliminary load estimating.

(e) Include design criteria for equipment cooling that supersedes and cancels Section 760-230-100.

2. SCOPE

2.01 Environmental control of telephone buildings is required to provide an environment that permits good equipment performance and a comfortable working environment. The environmental control system should be engineered for appropriate degrees of reliability and adaptability of changing conditions. Both initial and operating costs should be reasonable.

2.02 The energy problem dictates a need to place greater emphasis on energy conservation in the design of new buildings and facilities. The recommendations described in this section should result in reduced energy consumption and lower life-cycle costs by designing the mechanical systems closer to the actual loads.

3. OUTDOOR DESIGN PARAMETERS

3.01 The recommended outdoor temperatures to be used as a basis for design may be found in the following references:

(a) *American Society of Heating, Refrigerating, and Air-Conditioning Engineers (ASHRAE),* 1981, Fundamentals Handbook

(b) Department of the Air Force Manual, AFM 88-29, "Engineering Weather Data."

A. Summer Design Conditions

3.02 Summer design conditions are listed in the 1981 ASHRAE Fundamental Handbook, Chapter 24, Table 1. These data are the dry- and wet-bulb temperatures (°F) that are equaled or exceeded 1, 2-1/2, and 5 percent of the time, on the average, during the warmest 4 consecutive months. For design, use the values listed under the 2-1/2 percent frequency for ***attended*** buildings and the 5 percent for ***unattended*** buildings. For example, use the following design frequencies for building occupancies shown:

OCCUPANCY	DESIGN FREQUENCY (%)
Offices	2-1/2
#1/1A ESS	5
#2/1B ESS	5
#4 ESS	2-1/2

3.03 The outdoor design conditions for an office building located in Newark, New Jersey (Newark Airport Data) are determined from the reference, as 91°F dry bulb and 76°F wet bulb.

3.04 For the purpose of this document, an attended building is one which is occupied by at least one person for a minimum of one work shift, 5 days per week.

B. Winter Conditions

3.05 The winter design dry-bulb temperature is obtained from column 5 of Table 1 previously referenced. Use the value listed under 97.5 percent frequency for all buildings. For Newark, New Jersey, the winter design dry-bulb temperature is 14°F.

4. INTERIOR DESIGN PARAMETERS

4.01 Table A lists the recommended interior design parameters for the various occupancies shown.

5. VENTILATION REQUIREMENTS

5.01 Energy efficient mechanical systems (HVAC) control the amount of outdoor air introduced into buildings to that minimum amount required for ventilation.

5.02 It is recommended that ventilation rates for all occupancies be derived from *ASHRAE Standard 62*, dated 1981. Where local regulations require higher rates of ventilation, these regulations must be followed.

TABLE A

RECOMMENDED INTERIOR DESIGN PARAMETERS

SPACE	SUMMER DRY-BULB TEMP	%RH	WINTER DRY-BULB TEMP	%RH	NOTE
Battery Rooms					
(a) air conditioned	80	—	65	—	
(b) ventilated (outdoor air)	$\Delta T = 15°F$	—	65	—	1
Boiler Room	—	—	50	—	
Computer Rooms	—	—	—	—	2
Emergency Engine Room	$\Delta T = 15°F$	—	65	—	1
Garages	—	—	—	—	3
Mechanical Equipment Room	$\Delta T = 15°F$	—	60	—	
Power Rooms					
(a) air conditioned	80	—	65	—	
(b) ventilated (outdoor air)	$\Delta T = 15°F$	—	65	—	1
Telephone Equipment	80	50	65	20	
TSPS Rooms and other occupied spaces	78	50	65	—	

Note 1: Interior temperature = outdoor ambient temperature +15°F or 110°F maximum.

Note 2: Refer to Section 760-250-150 for specific design requirements.

Note 3: Refers to vehicle storage areas.

5.03 Copies of *ASHRAE Standard 62* can be obtained from:

ASHRAE Publications Sales
1791 Tullie Circle, NE
Atlanta, GA 30329

6. WIDEBAND TEMPERATURE OPERATION

6.01 The environmental conditions in most telephone equipment spaces can be satisfactorily maintained under Wideband Temperature Operations. Significant energy and cost savings will result as energy for the building mechanical systems serving central office areas is expended only to keep the average space temperature from exceeding 80°F in the cooling cycle and to prevent the average temperature from going below 65°F (occupied) or 55°F (unoccupied) when heating is required.

6.02 The design features of the control system should include the following:

(a) The operation of the mechanical refrigeration and heating systems is to be controlled by space thermostats not return-air thermostats.

(b) Where permissible, the fan system is to be operated only upon demand for heating or cooling.

(c) The control system shall prevent cooling down to the heating set point or heating up to the cooling set point.

6.03 It is recommended that fans serving No. 4 ESS* switching equipment be operated continuously. Cycling supply air fans is also not recommended for D1 and D2 channel banks.

6.04 Fans serving all other telephone switching systems can be cycled under control of space-mounted thermostats. Return-air thermostats are not recommended for fan cycling control.

6.05 Fan operation during periods when space temperature requirements are satisfied may be required to meet local ventilation codes (when space is occupied) or to meet the requirements of special telephone equipment.

* Trademark.

7. EQUIPMENT AND LIGHTING HEAT RELEASE

7.01 A detailed study plan, prepared by the Planning Engineer, showing an accurate layout of telephone equipment to be installed must be furnished to the Design Engineer so that proper design evaluations can be made. The plan should show future equipment additions and when these additions can be expected. Where possible, the heat dissipation per unit of equipment should be marked on the equipment layout for each unit of equipment. These heat dissipations should be summarized per equipment row to indicate the locations of high heat concentrations. As a guide for planning purposes, the following average heat dissipation in watts per square foot may be used to ***estimate*** air-conditioning loads for a given equipment space. These values should not be used for the design and sizing of air-conditioning and refrigeration equipment.

EQUIPMENT	WATTS PER SQUARE FOOT
Step by Step	0.75
Panel	1.25
No. 5 X-Bar	2
No. 1 ESS	10
No. 2 ESS	9
No. 4 ESS No. 5 ESS	Heat release is dependant upon the equipment configuration and may range from 20 watts per square foot for the overall area to 50 watts per square foot in some equipment aisles.
TSPS No. 1	30
ETS	47

7.02 The use of excessive values for the telephone equipment heat dissipation will result in air-conditioning equipment that is oversized and inefficient.

7.03 For comparison, the former electromechanical step-by-step and crossbar systems used 0.9 watts per line. The earlier ESS switching equipment consumed 2.2 watts per line as compared with the present analog switching equipment which uses approximately 1 watt per line. The present digital ESS switching equipment consumes approximately 2 watts per line.

7.04 Heat dissipation information for telephone equipment is available in the Telephone Office Planning and Engineering System (TOPES) data section and the Floor Plan Data Sheets (FPDS). It is recommended that ***only*** the planning value from TOPES-Data or the 24-hour average value from FPDS be used for sizing HVAC equipment.

7.05 The TOPES-Plan section will develop a list of telephone equipment frames that are required to provide service for a particular line size of office. It will also summarize the planning heat-release values for the frames; however, it should be noted that the summation does not include heat release for toll terminal or power equipment.

7.06 Heat dissipation values for toll terminal and power equipment should be calculated separately from current FPDS information.

7.07 The ***lighting demand*** coincident with the equipment heat release must be added to the latter when estimating air-conditioning loads. The lighting demand can vary from 50 to 80 percent of the ***connected*** lighting load. The following heat release from lighting may be used:

AREA	WATTS PER SQUARE FOOT
Telephone Equipment Areas	0.5
Office Areas	1.5

8. LOAD ESTIMATING

8.01 During the early planning and/or preliminary design of a project, an estimate of the refrigeration and air volume required to air-condition a given space or building is required for electric service considerations and mechanical equipment room space requirements.

8.02 Also, load estimating is required to enable evaluation of building construction and orientation alternatives which impact upon the building energy forecast.

8.03 To minimize energy consumption and energy costs, the conductance of heat (U factor) through the exposed surfaces of the building such as walls, roof, and fenestration should be optimized, consistent with the local climatic conditions and the internal heat load. This is called the optimum U.

8.04 A program is available in the TOPES which permits the user to obtain such values of U. This program is designated INSUL. (See Section 760-310-100*.)

8.05 The current ASHRAE Fundamentals Handbook should be used as the source of all data required to calculate air-conditioning and/or heating loads.

8.06 Safety factors should not be used when calculating the exterior building envelope load. Any minor effect on the building temperature caused by temperature above outside design conditions can be tolerated by the telephone equipment.

9. SPACE REQUIREMENTS FOR MECHANICAL EQUIPMENT

9.01 Space requirements for air-handling equipment may be estimated from the following guidelines:

(a) One or two air-handling casings—35 to 40 square feet per 1000 CFM

(b) Three or more air-handling casings—40 to 45 square feet per 1000 CFM.

Note: An air-handling casing is defined as an enclosure housing filters, cooling coils, heating coils, and fans.

9.02 Space for refrigeration equipment including pumps is difficult to relate to cubic feet per minute. Consideration must be given to the type of equipment and especially to tube pull requirements. Very often, small direct expansion (DX) systems (up

*Check Divisional Index 760 for availability.

to 40 or 50 tons) can be incorporated with the air-handling equipment room without additional floor space. This is usually accomplished by locating the compressor unit under the duct work.

(a) Estimated floor space for refrigeration equipment and associated pumps are shown in Table B. The space allocations for two units assumes the units are adjacent to each other (ie, parallel). The dimensions include space for one condenser-water pump and one chilled-water pump per refrigeration unit. The headroom for units through 500 tons should be 12 feet (minimum) and 15 feet for the larger sizes. Serious attention should be given to column locations. The space dimensions listed above are predicted on regular column spacings on a 20- by 20-foot grid. If the column spacing is irregular, the floor areas will have to be increased.

(b) Estimated floor space for duct shafts:

1 square foot per 850 CFM up to 5100 CFM

1 square foot per 1000 CFM over 5100 CFM.

10. LOCATION OF MECHANICAL EQUIPMENT ROOMS (MER)

10.01 The proper location of the air-handling and refrigeration rooms (designated as MER) is critical to the successful design of a building. The final layout will have a significant effect on:

(a) Future growth of the building

(b) Present and future telephone equipment layouts

TABLE B

ESTIMATED FLOOR SPACE FOR REFRIGERATION EQUIPMENT AND ASSOCIATED PUMPS

EQUIPMENT	SIZE	SPACE REQUIREMENTS (FEET)
Reciprocating Chillers	Up thru 100 tons — 1 unit	20 × 15
Reciprocating Chillers	Up thru 100 tons — 2 units	20 × 20
Centrifugal Chillers	250 thru 500 tons — 1 unit	25 × 30
Centrifugal Chillers	250 thru 500 tons — 2 units	35 × 50
Centrifugal Chillers	700 thru 1200 tons — 1 unit	35 × 45
Centrifugal Chillers	700 thru 1200 tons — 2 units	35 × 60
Steam Absorption	100 thru 260 tons — 1 unit	20 × 40
Steam Absorption	100 thru 260 tons — 2 units	30 × 40 or *25 × 60
Steam Absorption	300 thru 500 tons — 1 unit	30 × 40
Steam Absorption	300 thru 500 tons — 2 units	40 × 40 or *30 × 60
Steam Absorption	500 thru 700 tons — 1 unit	35 × 50
Steam Absorption	500 thru 700 tons — 2 units	60 × 60 or *35 × 80
Steam Absorption	700 thru 1000 tons — 1 unit	30 × 70
Steam Absorption	700 thru 1000 tons — 2 units	50 × 70

* These dimensions are for machine arrangements utilizing common tube pull space.

(c) Acoustic sound levels inside and outside the building

(d) Economic evaluations of the building, related mechanical equipment, and services.

10.02 Two types of buildings that will be considered are:

(a) Central office (CO) buildings that have telephone equipment and few occupants

(b) Office buildings that have office-type equipment and many occupants.

10.03 The mechanical designer must work closely with the architect during the initial design stages to develop the best MER layout consistent with the type of building taking into account the present installation and future expansions. The requirements for MER layouts differ for each type of building. Some of the common features and important differences will be described in the following material.

A. General Features

10.04 General features that must be considered for either type of building are:

(a) Air intakes and exhausts

(b) Duct work and piping passage

(c) Physical entry space for mechanical equipment

(d) Acoustic isolation

(e) Thermal insulation.

Air Intakes and Exhausts

10.05 The layout location should ensure a plentiful supply of uncontaminated air for supply and permit air to be exhausted. Uncontaminated air refers to air that is free from auto exhausts, chimney emissions, emergency engine exhausts, and noxious industrial odors. The MER should be adjacent to an outside wall. Air intakes and exhausts must be separated as much as possible, and the prevailing wind direction must be checked to prevent recirculation.

10.06 Air intakes and exhausts must be positioned so that noise from the MER, or the intakes themselves, will not cause problems in adjacent and opposite spaces through windows or walls. Special care must be taken in residential areas to avoid complaints from nearby residents.

10.07 The air intake and exhaust openings must be located so they can be protected from vandals or persons intent on causing damage. Openings should be above the street level and away from the building property line. The locations of air intake and exhaust openings must be checked for compliance with local building codes.

Duct Work and Piping Passage

10.08 Avoid blocking off the access space for duct work and piping into and out of the MER by not locating it next to a stairway, an elevator shaft, an electrical equipment room, or a telephone closet. At least two interior walls should be left free for piping and duct work to enter and leave. In a CO building, the floor plan is based on the most efficient layout of equipment frames for present usage and future growth. The MER must be located so that the duct work and piping passage does not interfere with the CO equipment layout. Proposed growth must be considered since the telephone equipment is set up in rigid, predefined patterns.

Entry Space

10.09 It is poor practice to locate and lay out an MER without consideration to space for maintenance, additions, and removal of equipment. Adequate aisle space must be provided not only in but also for access to the MER. In the office-type building, a passage can be made by temporarily removing interior partitions as required. In CO buildings, telephone equipment and permanent interior partitions will not allow a passage to be made. Preplanning for equipment access is important.

Acoustic Isolation

10.10 Acoustic isolation and control is important in both types of buildings.

(a) ***Central Office Buildings:*** The noise generated within most CO spaces will usually mask out all but the most severe mechanical equipment noise. The MER wall should have all openings for ducts, piping, and conduits sealed by using a filler such as mineral wood or fibrous glass with a flexible caulking compound over the filler. Internal duct lining must not be used in duct systems serving equipment areas because of the possibility of material flaking in the air stream and depositing on switching equipment. Avoid placing heavy reciprocating or rotating machinery on upper floors of the building. This not only creates noise problems but also means extra reinforcement for the floors and columns associated with the equipment area. Equipment within the MER should be mounted on vibration isolators. Piping connected to reciprocating or rotating equipment should be supported by vibration isolation mountings.

(b) ***Office Buildings:*** The acoustic problems are the most difficult to handle due to the variations in space occupancy and the occupants themselves. The MER should be located remotely from areas which must be "quiet" by the nature of their occupancy (eg, private offices, quiet rooms, lounges, medical departments, and legal departments). During the initial design stages, consideration should be given to the isolation of the mechanical equipment spaces by placing buffer zones composed of corridor space, storage areas, or repair spaces adjacent to the machinery room. Special care should be taken so that executive floors are not located directly over or below MERs. If occupied office spaces are above or below the equipment room, the floor and ceiling must be treated to prevent the transmission of sound. Even with concrete flooring, a suspended ceiling on the floor below may be needed to achieve adequate sound transmission reduction. If the ducts pass through spaces which must have low ambient sound level, the duct work entering and leaving the mechanical equipment room can be internally lined. Duct work, piping, and conduit should be sealed as described in paragraph 10.10(a). In addition, the equipment room door should be gasketed. The mechanical equipment should be mounted on vibration eliminators, and piping should be hung on isolation hangers to prevent vibration transmission to other areas of the building. Avoid placing heavy reciprocating or rotating machinery on upper floors of the building. This not only creates noise problems but means extra reinforcement for the floors and columns associated with the equipment area.

Thermal Insulation

10.11 In a normal installation, the mechanical equipment room is heated in the winter and ventilated during the summer. Additional thermal insulation will not be required unless the adjacent spaces must have special treatment with regard to temperature and humidity. Only for special cases should an evaluation of insulation for walls, ceilings, etc, be made to determine if excessive heat losses, heat gains, or moisture migration will affect adjacent spaces.

B. Preferred Location for MER in CO Equipment Building—MER Per Floor (Fig. 1 and 2)

10.12 The most desirable layout is a separate MER on each floor housing the air-handling supply and exhaust equipment for that floor only. The room location must be predicated on the present and future telephone equipment layouts. The refrigerating and pumping equipment is located at the lowest level in the building with provisions for future expansion.

> ***Note:*** If the building has an MER per floor as described above, it will usually require no more total floor space than will one central mechanical equipment room with separate air-handling equipment for each floor and the related duct shafts up and down the building to service each floor.

10.13 The MER must also meet the following criteria:

(a) Appropriately sized and protected air intake and exhaust openings meeting all local codes.

(b) At least two interior walls for each MER will be left free for passage of duct work and piping for present and future growth (no interference with telephone equipment).

(c) Entry space inside MER and adjacent to room to permit maintenance and removal.

(d) All rotating machinery on vibration isolators.

(e) All piping inside MER on vibration isolators (only if connected to rotating or reciprocating equipment).

(f) No electrical interference with electronic switching equipment.

Advantages of Separate MERs Per Floor

10.14 The advantages of separate MERs per floor are:

(a) To have flexibility for future revisions and expansions

(b) To have modifications on one floor—does not disturb another

(c) To have space occupancies requiring different conditions

(d) To have fire protection—duct work does not penetrate floors

(e) To have heavy refrigeration and pumping equipment kept at lowest level

(f) To have upward expansion of building

(g) To have smaller outside air openings instead of one large opening

(h) To have short, duct runs.

Disadvantages of Separate MERs Per Floor

10.15 The disadvantages of separate MERs per floor are:

(a) To have more than one mechanical equipment room to service

(b) To have leaks in water lines on upper floors that can cause damage on lower levels

(c) To have fan rooms and refrigeration equipment separated

(d) To have long, piping runs.

C. Acceptable Location for MER in CO Equipment Building—Central MER (Fig. 3 and 4)

10.16 This layout has one MER for all the air-handling equipment servicing the building. The air-handling equipment consists of a separate supply and return unit servicing each floor. The refrigeration equipment should be located at the lowest level in the building. The air-handling MER can be located in either of the following locations:

(a) At the lowest level in the building where it can be either a separate space or combined with the refrigeration equipment

(b) On the roof, as a penthouse, with the refrigeration equipment remaining at the lowest level. Shafts are required for the vertical duct work and horizontal branch ducts serve each floor. Note that the duct shafts must not interfere with CO equipment growth.

10.17 The MER locations must also meet the following previously described criteria:

(a) Appropriately sized and protected air intake and exhaust openings meeting all local codes.

(b) Two or more interior walls should be left free for duct and piping passage if the vertical shafts are outside the confines of the mechanical equipment room. When the shafts originate in the equipment room, this requirement can be relaxed to meet the job conditions.

(c) Ample space must be left around air-handling and refrigeration equipment. A penthouse MER should have outside roof access so equipment can be lifted to and from the roof. A lower level MER should have access to the street level for removing equipment.

(d) The penthouse MER should have all rotating machinery and piping on vibration isolators. The lower level MER should have normal treatment of equipment and piping for both air-handling and refrigeration equipment.

(e) Extra thermal insulation if necessary.

Advantages of a Central Equipment Room With Individual Supply and Exhaust Units Supplying Each Floor

10.18 The advantages of a Central Equipment Room with individual supply and exhaust units supplying each floor are as follows:

(a) All equipment can be serviced at one time.

(b) An air-handling room in a penthouse would have a good protected source of outdoor air.

(c) A lower level room would eliminate piping and water services from upper floors and would be above the telephone equipment.

(d) Heavy refrigeration and pumping equipment will be kept at lowest level.

(e) Building can expand upward if all equipment is on lower level.

(f) Space occupancies requiring different conditions can be more easily accommodated.

(g) Air-handling and refrigeration rooms on lower level would require shorter pipe runs and less pump horsepower.

(h) There would be less chance of electrical interference with electronic switching equipment.

Disadvantages of a Central Equipment Room With Individual Supply and Exhaust Units Supplying Each Floor

10.19 The disadvantages of a Central Equipment Room with individual supply and exhaust units supplying each floor are as follows:

(a) Future revision could require work in duct shafts which would disturb other systems. Disturbing duct work would cause entrapped dirt to be released into telephone spaces.

(b) Not enough space is left in duct shafts to accommodate future changes.

(c) A building expansion upward may block air intakes and exhausts if a penthouse for air-handling equipment is used. This depends on the location of the penthouse.

(d) Fire protection is difficult because the duct shafts penetrate floors.

(e) A penthouse air-handling room presents a hazard due to potential water leakage.

(f) Layout of vertical shafts for services might interfere with equipment floor layouts.

(g) Air intakes and exhausts may be difficult to protect. It may also be difficult to meet local code requirements.

(h) The fan horsepower is higher.

(i) Penthouse floor must be waterproofed at additional cost.

D. Unacceptable Configuration — Single Air-Handling System — CO Equipment Building

10.20 The previous paragraphs have been based on the philosophy of one air-handling system per floor regardless of the location of the air-handling equipment. It is often proposed that one air-handling system be used to supply several floors, rather than an individual system per floor. This particular configuration should be discouraged for the following reasons:

(a) The size of the motor and the emergency generator will depend on the volume of air to be handled.

(b) Fire protection becomes difficult when duct work connects one floor to another. There is always the possibility of smoke being transmitted from floor to floor unless additional smoke-actuated dampers are installed.

(c) One system is acceptable for CO equipment requirements. However, buildings which house more than CO equipment (ie, operating rooms, quarters, etc) would require at least two systems: one for CO equipment and one for personnel requirements.

(d) Maintenance on a fan or coil would put the entire building out of operation until the repairs are completed.

10.21 The preceding paragraphs have stated the major objections to one central air-handling system for a CO building. However, there are advantages that may outweigh the disadvantages.

(a) The total installed horsepower is less.

(b) The capability to manipulate air quantities and redistribute them from floor to floor as occupancy requirements change is greatest with this configuration.

(c) The first cost and space requirements are less than for individual systems.

E. Location of MERs in Suburban-Type Office Buildings

10.22 Suburban-type buildings are two to three stories in height with a horizontal layout and are staffed primarily by telephone company clerical personnel. The perferred location for the MER is in the lowest building level (Fig. 5). The air-handling equipment consists of a perimeter system and an all-air system for the interior spaces. These two types of systems service all spaces in the building, unless non-typical conditions exist in which case a separate system will be required. The refrigeration equipment is located on the lowest level and generally the two spaces are combined into one common room.

10.23 The MER location must meet the following criteria:

(a) Appropriately sized and protected air intake and exhaust openings must meet all local codes.

(b) Two or more interior walls must be left free for duct and piping passages if the vertical shafts are outside the confines of the MER. When the shafts originate in the equipment room, this requirement can be relaxed.

(c) Ample space must be left around air-handling and refrigeration equipment. The MER must have access to the street for removal of air-handling and refrigeration equipment.

(d) Rotating machinery and piping must be located on vibration isolators for both air-handling and refrigeration spaces.

(e) Extra thermal insulation if necessary.

Advantages of a Lower Level Central Equipment Room

10.24 The advantages of a lower level Central Equipment Room are as follows:

(a) All equipment can be serviced at one time.

(b) Noisy equipment will be kept away from the occupants.

(c) Service personnel do not enter occupied areas.

(d) Building can expand upward if ample duct and equipment room space is provided.

(e) Air-conditioning capabilities can be shifted from one area to another by varying air quantities.

(f) Pipe runs will be shorter with less pump horsepower if air-handling rooms are located near the refrigeration room.

Disadvantages of a Lower Level Central Equipment Room

10.25 The disadvantages of a lower level Central Equipment Room are as follows:

(a) Fire protection is difficult because duct shafts penetrate floors.

(b) Air intakes and exhausts may be difficult to protect. It may also be difficult to meet local code requirements.

F. Location of MERs in High-Rise Office Buildings

10.26 High-rise buildings are of multistoried construction. They are designed for telephone company office personnel. The air-handling equipment consists of a type of perimeter system(s) and an all-air system(s) for the interior spaces. These two types of systems will service all spaces in the building unless nontypical conditions exist, in which separate systems will be required.

10.27 There are many variables to consider when locating MERs in office-type buildings—the most significant being usable space. Experience has indicated that central air-handling rooms (feeding up, down, or both ways) with the required duct shafts provide the best usable-to-gross area ratio. Similarly, the break point for reasonable duct shaft space is for one central equipment room to service approximately 8 to 12 floors in either direction. For the purposes of this discussion, high-rise buildings are divided into two categories:

(a) High-rise buildings—up through ten floors

(b) High-rise buildings—over ten floors.

High-Rise Buildings—Up Through Ten Floors (Fig. 6)

10.28 The preferred layout is to have two air-handling equipment rooms and one refrigeration/pump room. One air-handling room is to be at the lowest level and the other at the top-most level. The low-level room with its equipment services the below-grade areas and occupied spaces in the lower half of the building. The refrigerating and pumping equipment located at the lowest level serves the entire building. The upper air-handling room serves all spaces in the upper half of the building. Shafts are provided to enclose duct work and piping.

10.29 The MER locations must meet the following general criteria:

(a) The penthouse makes it convenient to satisfy the outside and exhaust air requirements.

(b) The lower level MER must have the air intakes and exhausts protected, and it must meet all local codes.

(c) Floor area must be left in the penthouse in order to provide duct and piping space to carry services to lower levels.

(d) Space must be left around air-handling and refrigeration equipment. The penthouse MER must have outside access so equipment can be lifted from the roof. The lower level refrigeration room must have access to the street level for removing equipment.

(e) The penthouse MER must not be located over executive-type spaces because of potential noise problems. Rotating machinery and piping must be put on vibration isolators. The lower level refrigeration pump and air-handling MER would have normal treatment of equipment and piping.

Advantages of Central Fan Rooms

10.30 The advantages of Central Fan Rooms are as follows:

(a) All air-handling equipment can be serviced at one time.

(b) The penthouse MER has a good protected source of outdoor air.

(c) Potential noise problems can be avoided by keeping refrigeration and pumping equipment on the lowest level.

(d) Street level occupied spaces can have their own independent air-handling systems.

(e) Maintenance personnel do not have to enter occupied areas.

(f) Prime space on individual floors is not taken by MERs.

Disadvantages of Central Fan Rooms

10.31 The disadvantages of Central Fan Rooms are as follows:

(a) The breakdown of equipment (ie, interior system supply fan) will affect large areas of the building.

(b) Security may be difficult on intakes for lower level MERs.

(c) The penthouse MERs require special consideration to reduce sound transmission.

(d) Fire protection is more difficult because of duct shafts.

High-Rise Buildings—Over Ten Floors (Fig. 7)

10.32 The mechanical equipment spaces required for a multistory building over ten floors are a function of the building height. Common to all systems would be a refrigeration/pump at the lowest level. In instances of very tall buildings, it is not unusual to have refrigeration equipment located at the uppermost level since the piping runs can be held to a minimum. If the refrigeration equipment is to be located in the lower building levels, a review of pressure ratings is required.

10.33 Considering a 20-, 30-, and 40-floor building as being most likely to be within the scope of the Bell System requirements, then the following guidelines may be applied:

(a) For a 20-floor building, an air-handling equipment floor located at the intermediate level and feeding ten floors up and ten floors down, would be a reasonable solution.

(b) A 30-floor building would be in the category of two air-handling rooms: one at the intermediate level between the first and the twentieth floors and one penthouse equipment room serving the twenty-first through the thirtieth floors.

(c) For a 40-floor building, intermediate equipment rooms located at the eleventh and thirtieth floors would be a logical solution, considering ten floors up and down as reasonable criterion.

(d) All of the foregoing is broad in scope and must be evaluated with each particular building configuration as a specific instance. There is no magic to the tenth floor designation, but rather, it falls back to the amount of shaft space required for the duct work.

10.34 All of the criteria for equipment room layouts for high-rise buildings previously listed apply to this category.

11. SIZING OF MECHANICAL SYSTEMS FOR TELEPHONE EQUIPMENT

11.01 It is recommended that refrigeration capacity be installed to handle the initial cooling load plus the 5-year growth forecast. Additional refrigeration should be added when required on a measured load basis.

11.02 Duct work should be installed for the ultimate full building load. Dampers or blanking devices should be installed to shut off air from initially vacant areas.

11.03 The main air-handling unit fan should be sized for the ultimate air delivery required. Its speed should be reduced by changing sheaves to properly balance the initial system load.

12. MECHANICAL SYSTEM SELECTION

A. Life Cycle Costing

12.01 Life Cycle Costing is a process which takes first costs, operating costs, maintenance costs, and life expectancy into account for various alternative systems and compares the systems on a present worth basis.

B. Load Matching

12.02 It is important to analyze alternative systems in the appropriate range of the required cooling capacity. For example, a chilled-water system can be engineered and installed to handle a 20-ton cooling load. However, in most locations, the chilled-water system does not prove economical on a life-cycle cost basis until a cooling tower can be used in lieu of air-cooled condensers. This is generally in the 80- to 100-ton range. Section 760-550-212* discusses various types of refrigeration systems.

13. REFERENCES

13.01 Information contained in this section is based on Section 760-310-100—Building Envelope and Section 760-550-212—Refrigeration Systems and the following documents:

GL 77-10-025—Equipment Cooling Systems for No. 4 ESS, AT&T, October 7, 1977

IL 80-02-243—TOPES "INSUL" Program, AT&T, February 19, 1980

IL 81-04-389—Revisions to the No. 5 ESS Building Design Guide, AT&T, April 28, 1981

RL 81-01-096—No. 2/2B ESS Building Mechanical System Designer Guide, AT&T, January 15, 1981 (EL 7102)

RL 81-03-260—No. 5 ESS Building Design Guide, AT&T, March 18, 1981 (EL 7189)

RL 81-10-155—No. 1/1A ESS Building Mechanical System Designer Guide, AT&T, October 23, 1981 (EL 7261)

SR 80-09-019—Wide Band Temperature Operation, AT&T, September 3, 1980 (EL 6585)

American Society of Heating, Refrigerating, and Air-Conditioning Engineers (ASHRAE), 1981, Fundamentals Handbook

American Society of Heating, Refrigerating, and Air-Conditioning Engineers Standard 62, 1981, "Ventilation for Acceptable Indoor Air Quality."

*Check Divisional Index 760 for availability.

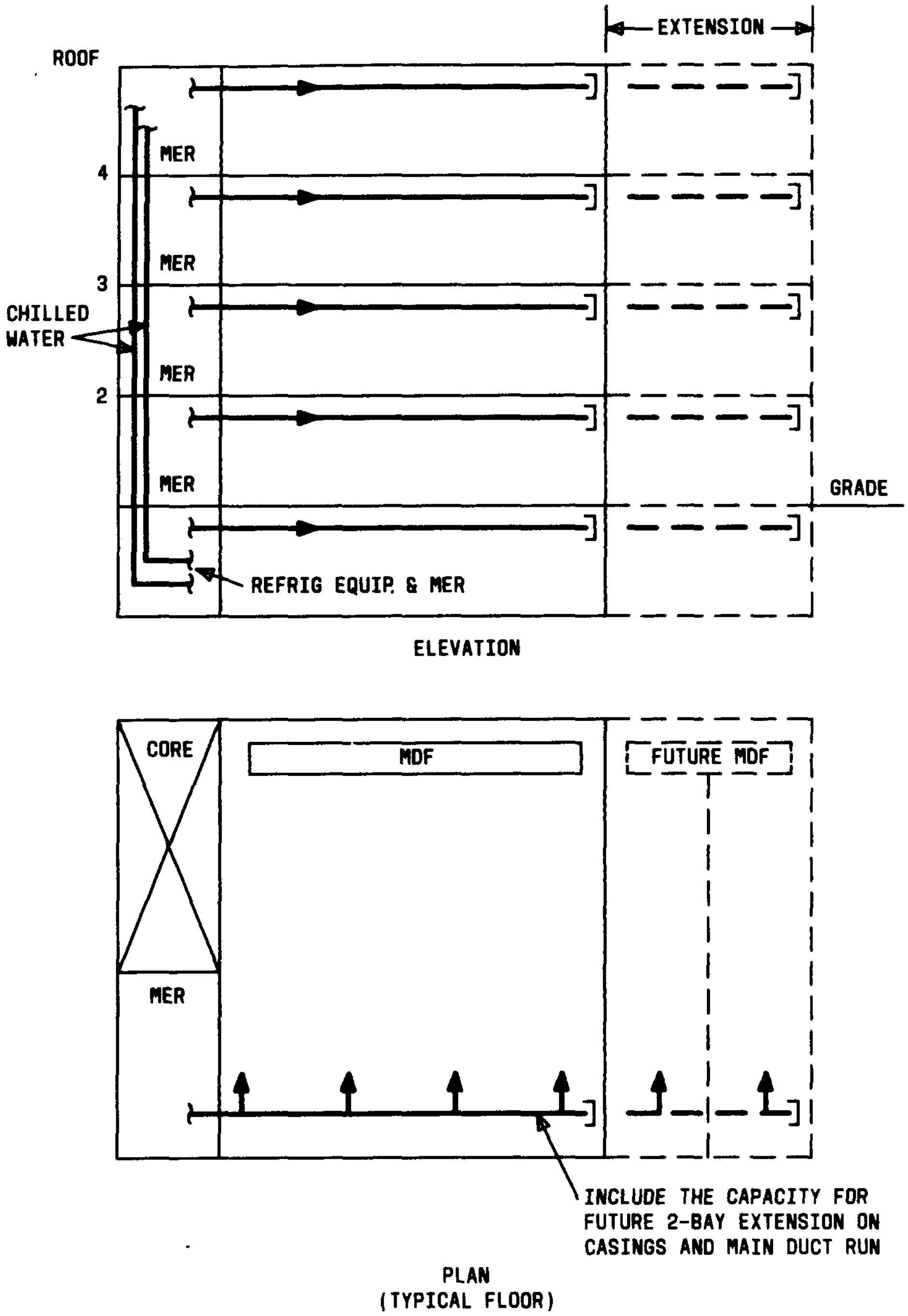


Fig. 1—Preferred Location for MER in CO Equipment Building (2-Bay Extension) (Sheet 1 of 2)

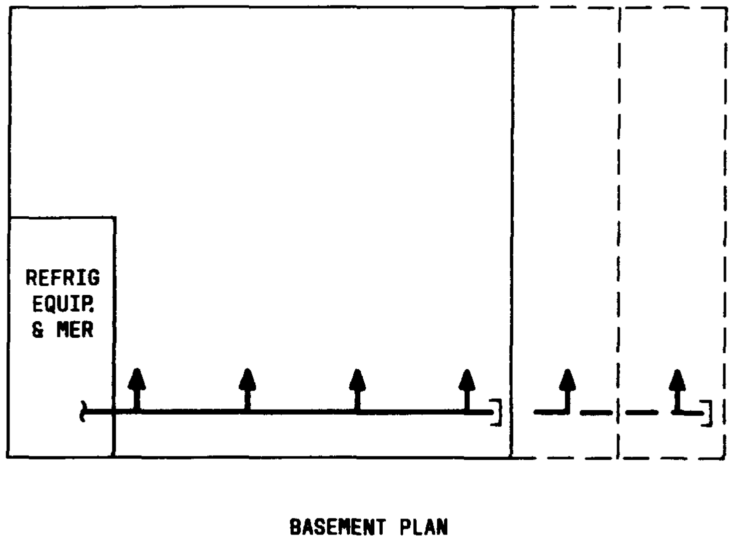


Fig. 1—Preferred Location for MER in CO Equipment Building (2-Bay Extension) (Sheet 2 of 2)

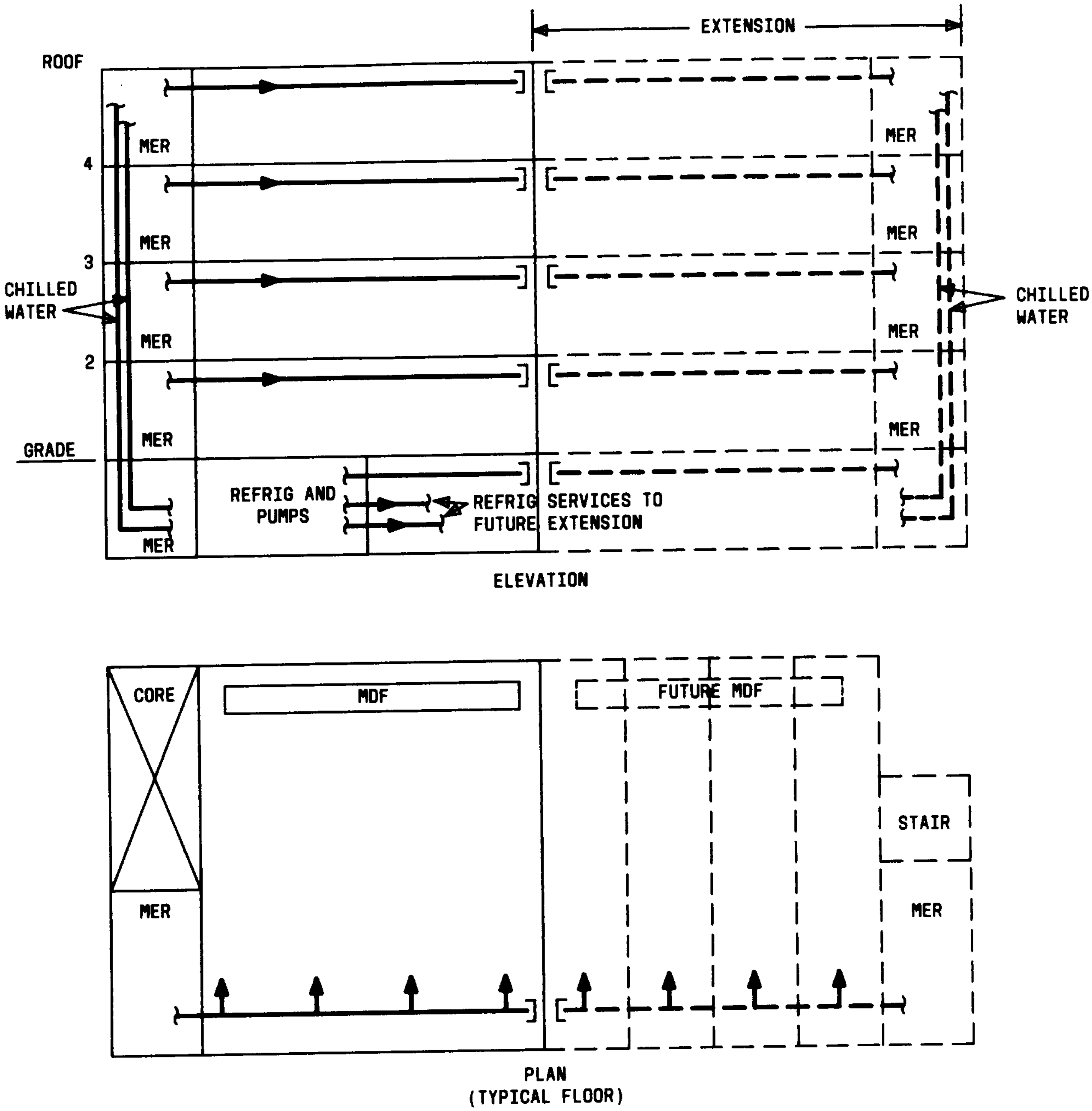


Fig. 2—Preferred Location for MER in CO Equipment Building (4-Bay Extension) (Sheet 1 of 2)

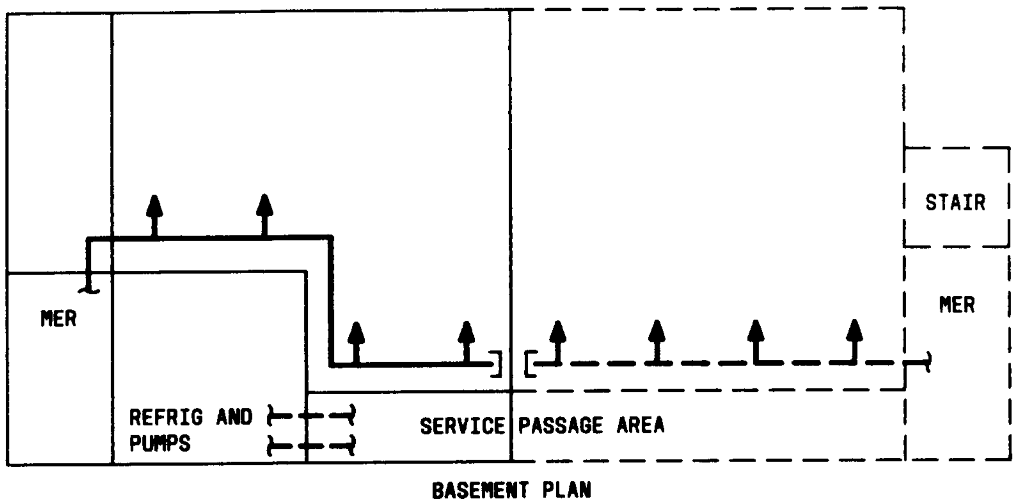


Fig. 2—Preferred Location for MER in CO Equipment Building (4-Bay Extension) (Sheet 2 of 2)

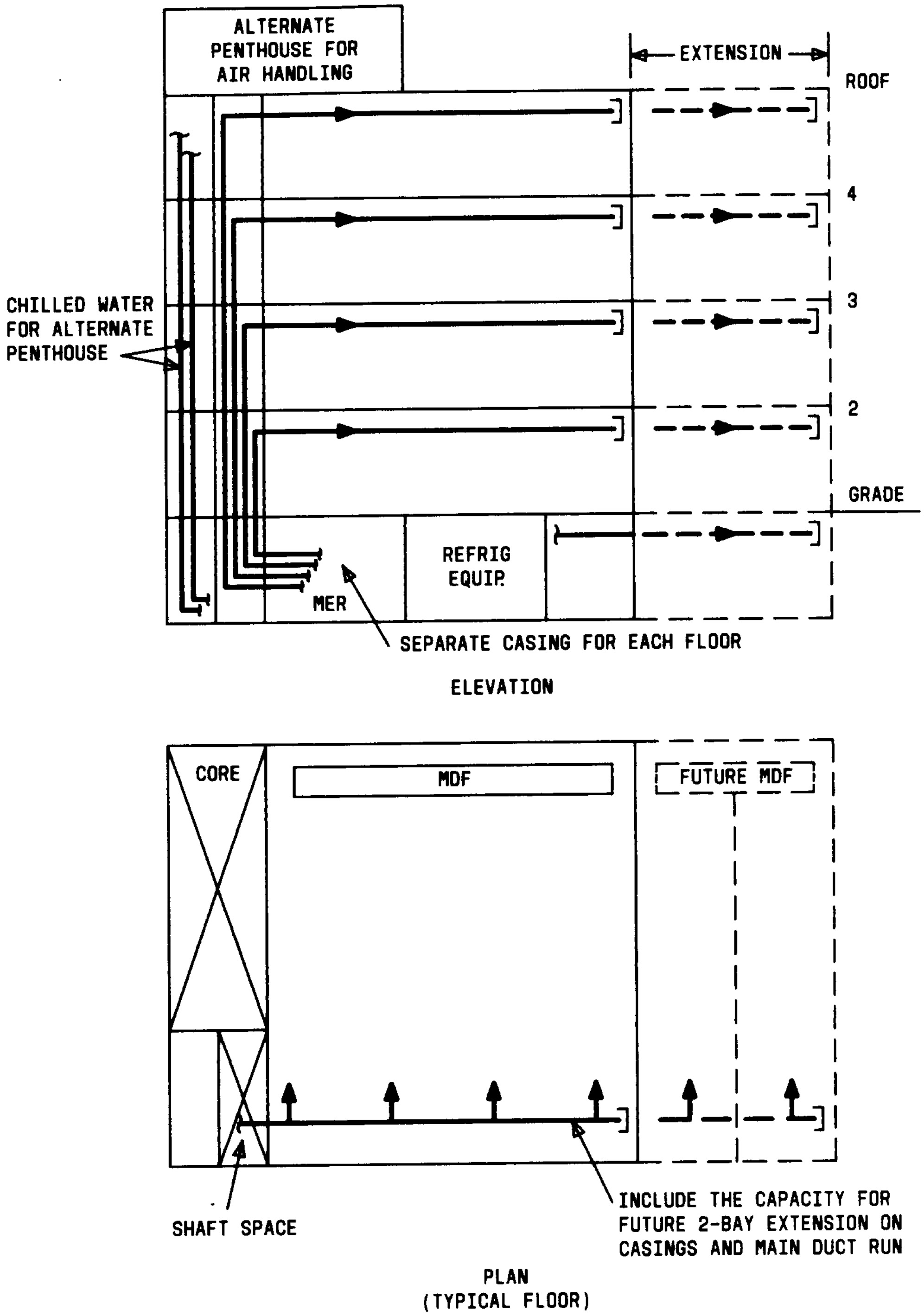
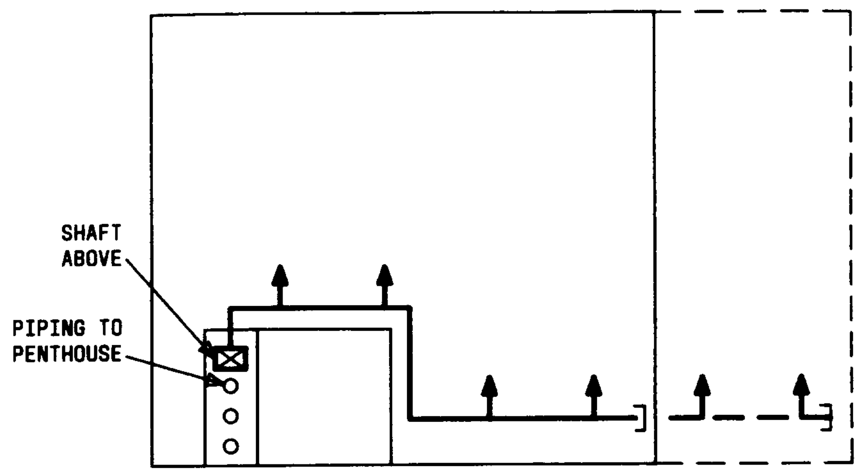
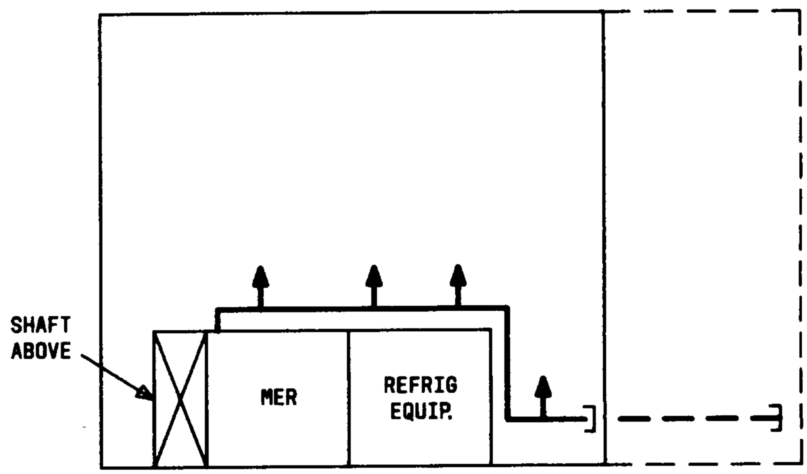


Fig. 3—Acceptable Location for MER in CO Equipment Building (2-Bay Extension) (Sheet 1 of 2)



BASEMENT PLAN
(ALTERNATE - WHEN PENTHOUSE IS ON ROOF, DUCT WORK FEEDS DOWN.)



BASEMENT PLAN

Fig. 3—Acceptable Location for MER in CO Equipment Building (2-Bay Extension) (Sheet 2 of 2)

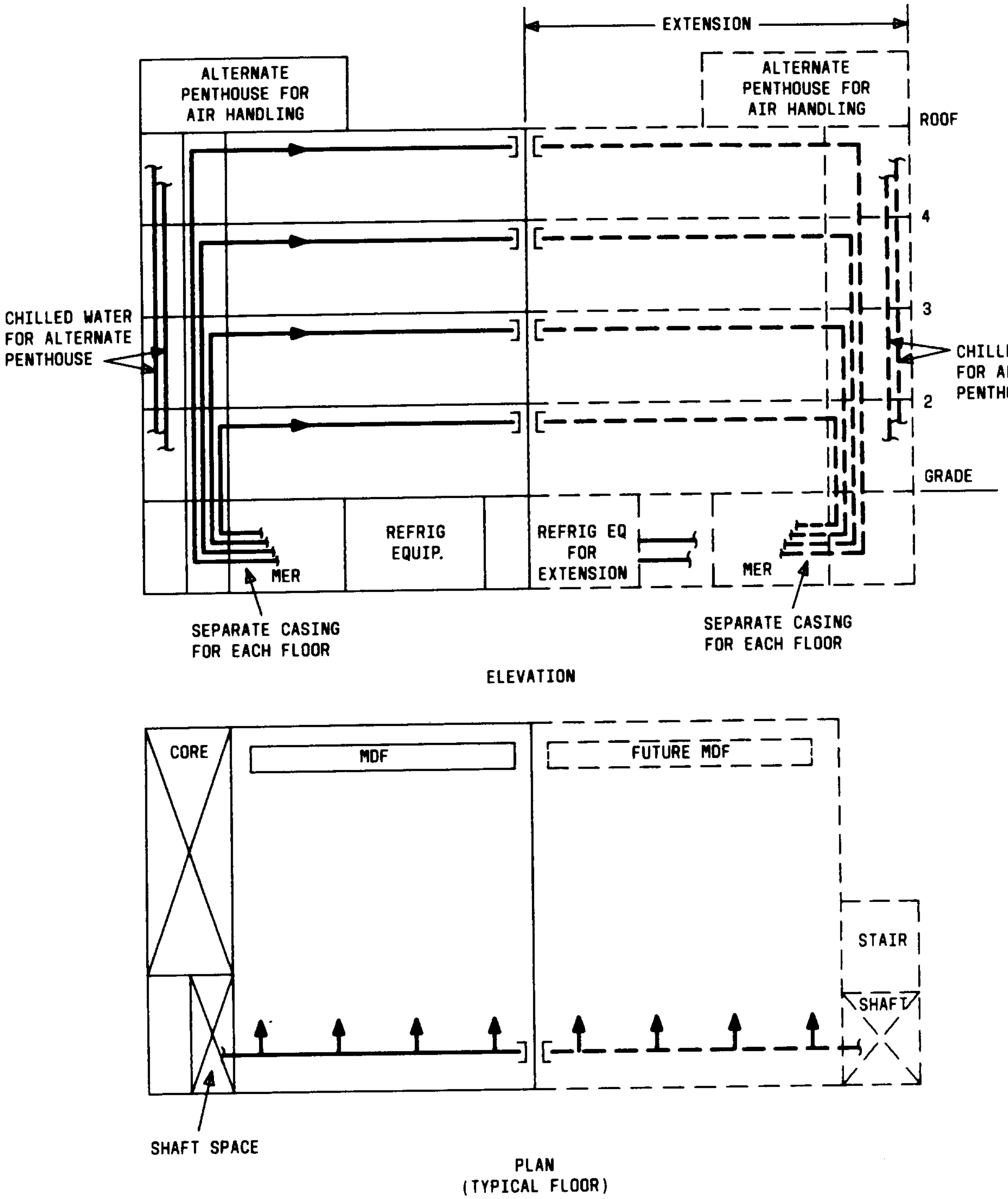
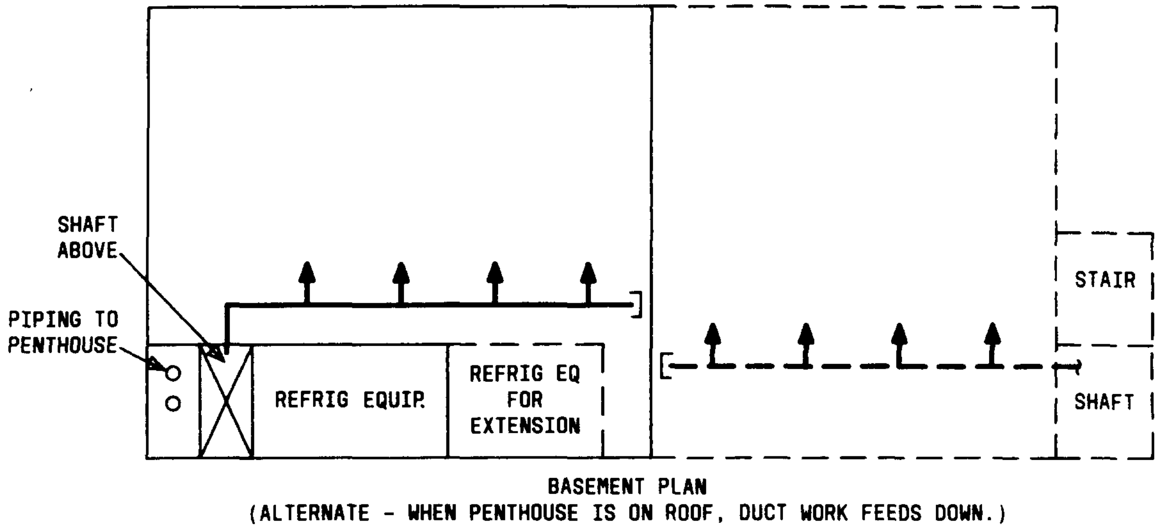


Fig. 4—Acceptable Location for MER in CO Equipment Building (4-Bay Extension) (Sheet 1 of 2)



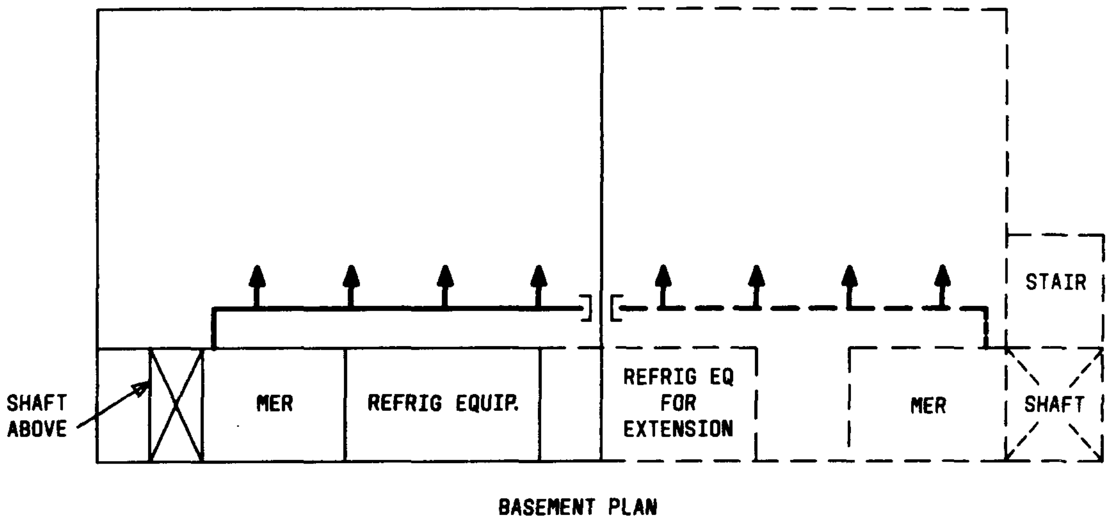
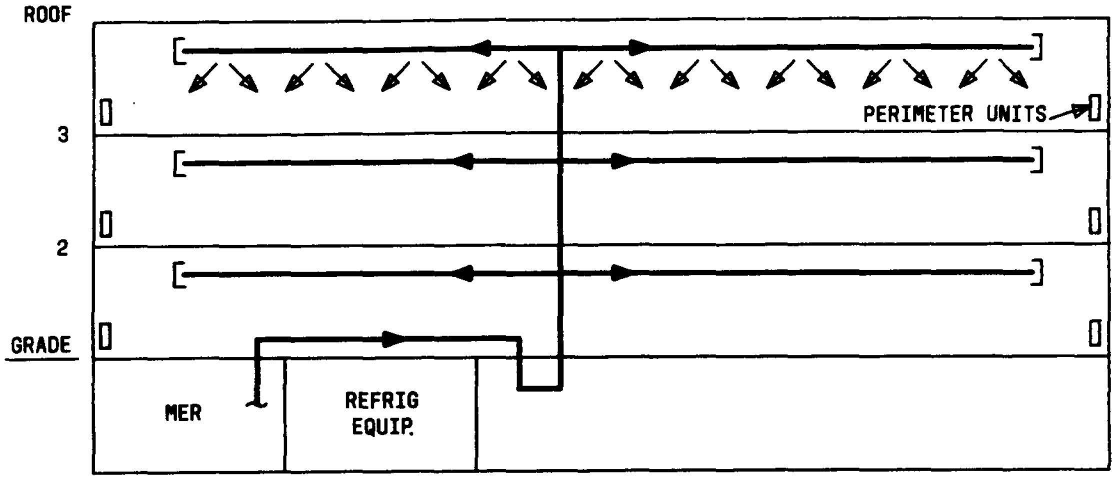
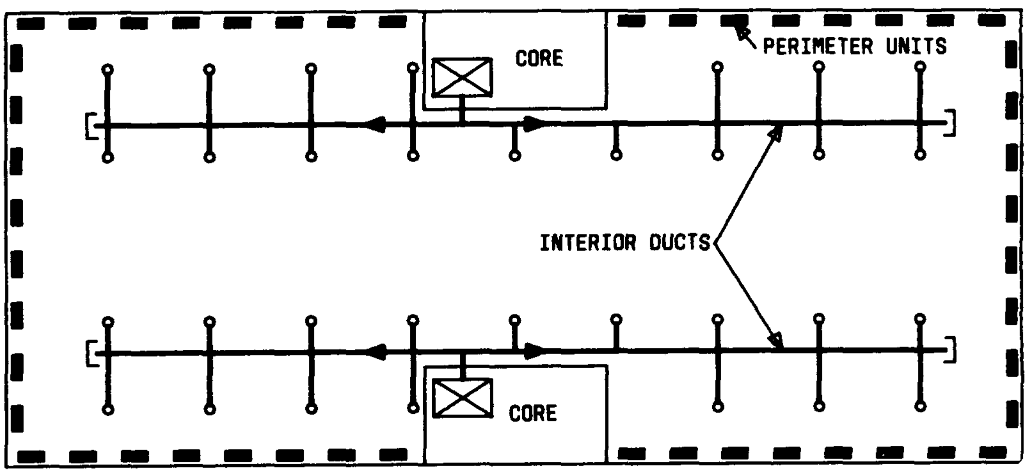


Fig. 4—Acceptable Location for MER in CO Equipment Building (4-Bay Extension) (Sheet 2 of 2)

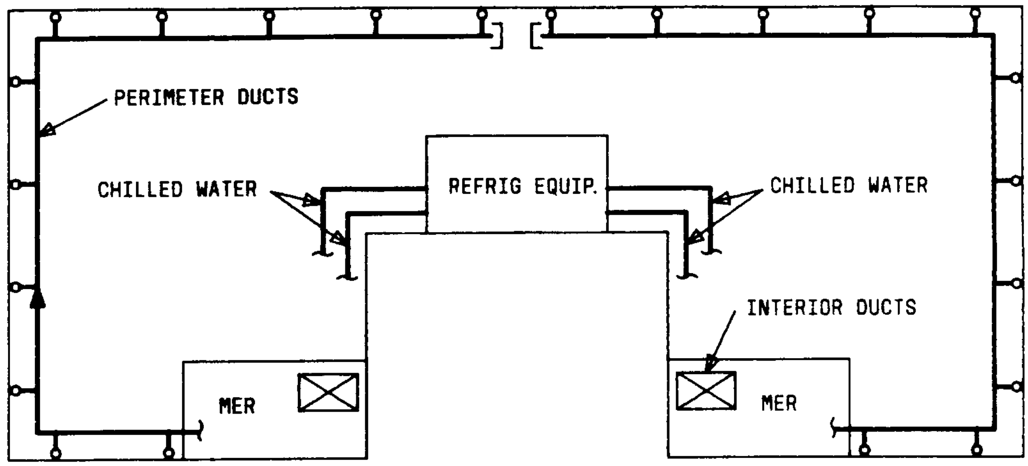


ELEVATION

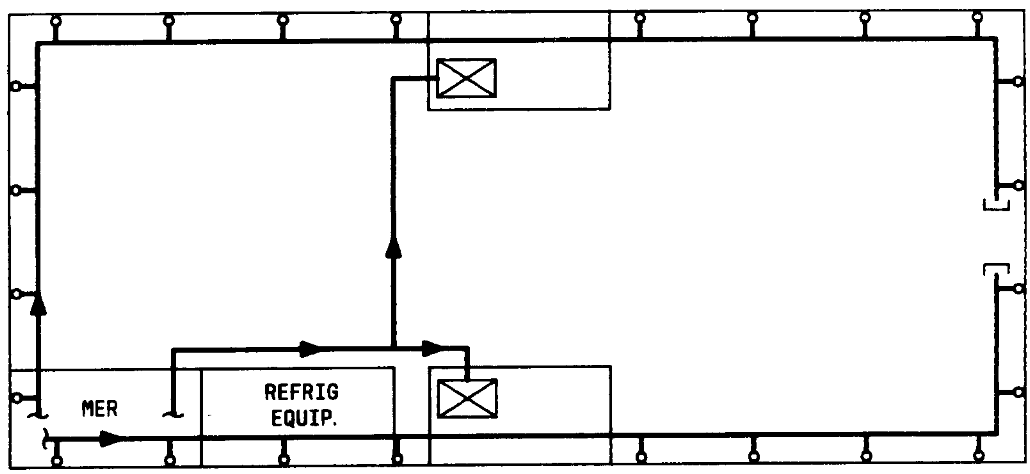


PLAN
(TYPICAL FLOOR)

Fig. 5—Suburban Office Building (Sheet 1 of 2)



BASEMENT PLAN
(ALTERNATE BUILDING CONFIGURATION)



BASEMENT PLAN

Fig. 5—Suburban Office Building (Sheet 2 of 2)

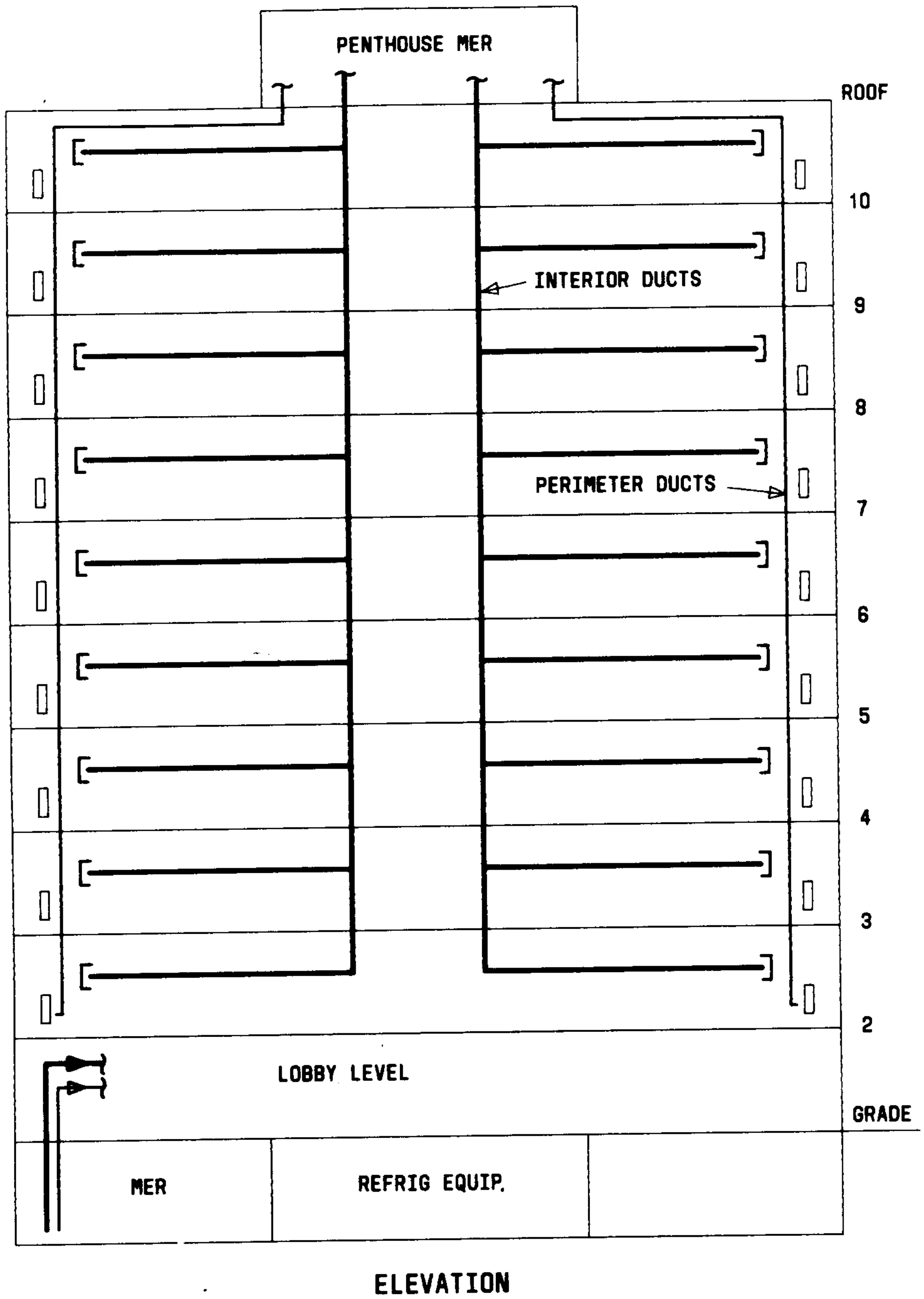
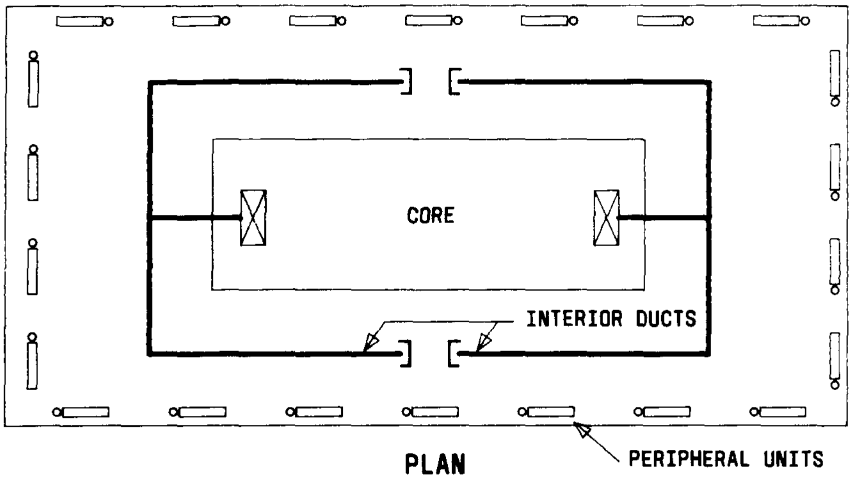
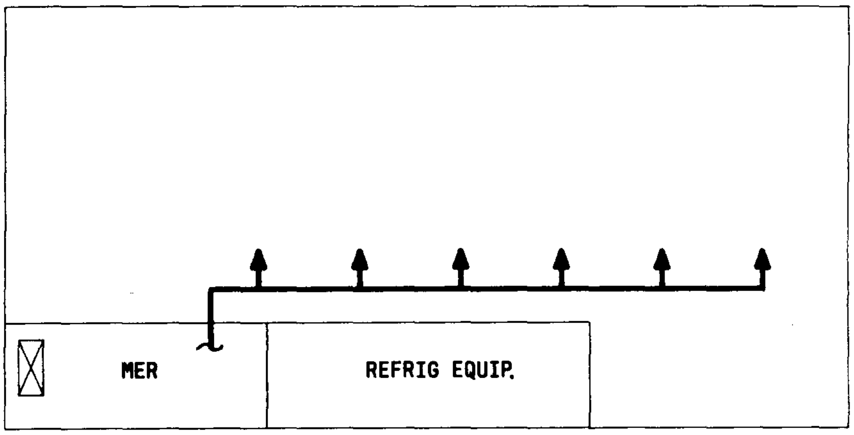


Fig. 6—High-Rise Office Building (Up to Ten Floors) (Sheet 1 of 2)



PLAN

(TYPICAL FLOOR)



BASEMENT PLAN

Fig. 6—High-Rise Office Building (Up to Ten Floors) (Sheet 2 of 2)

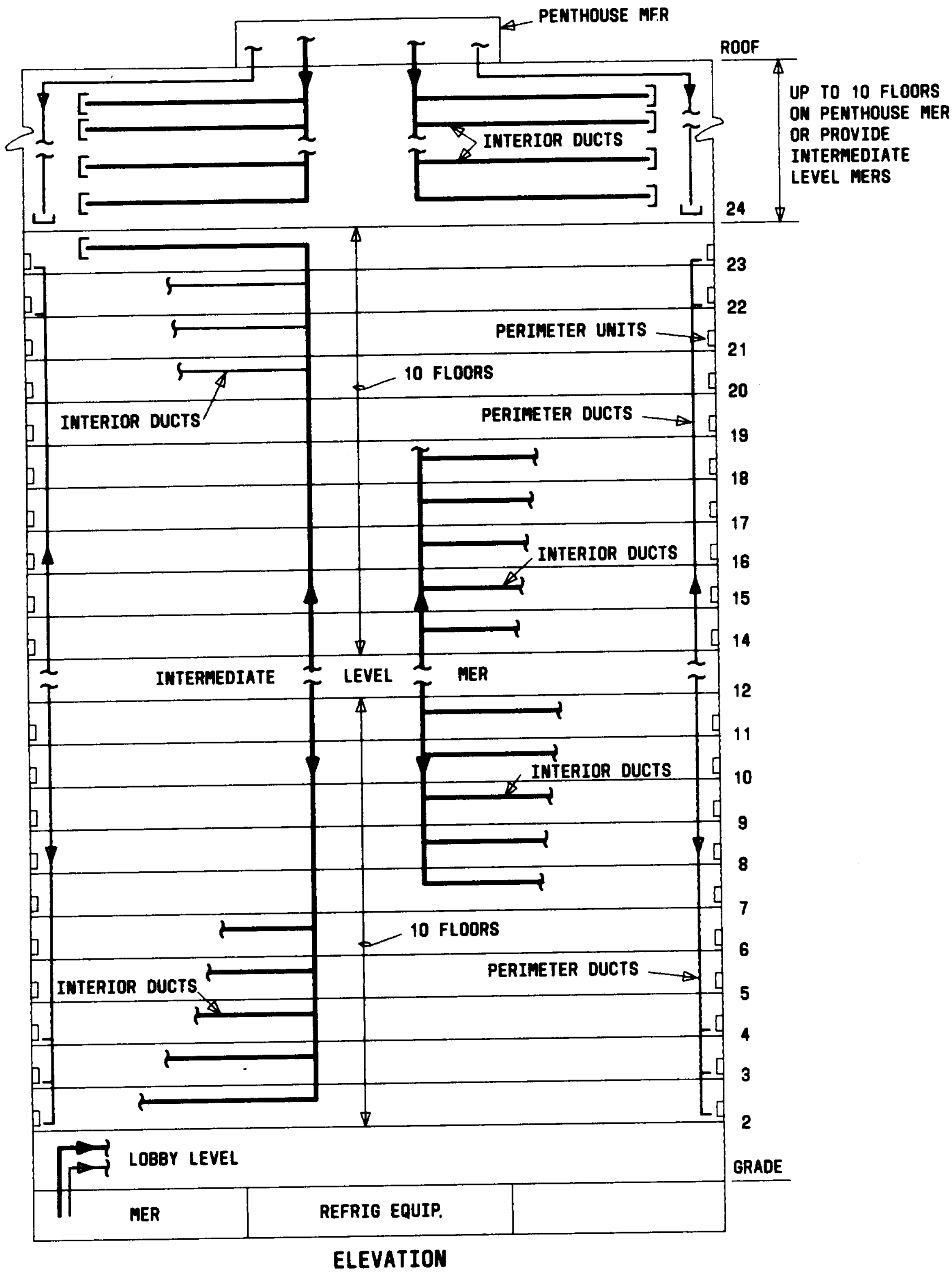
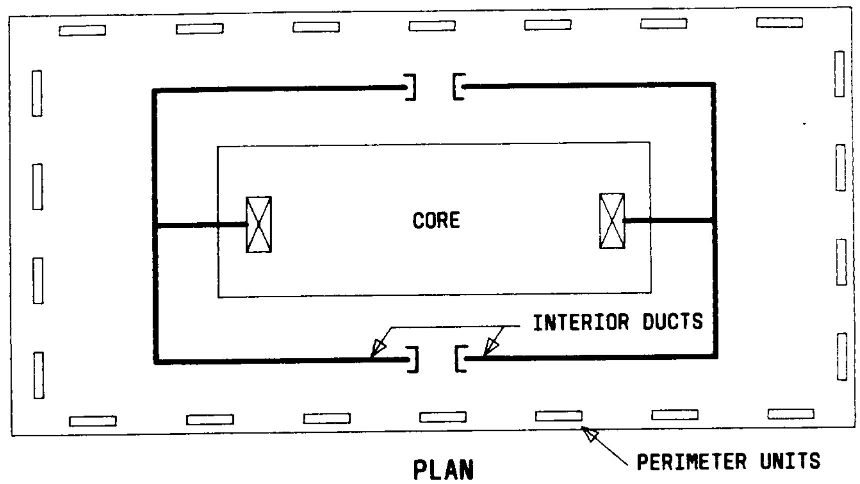
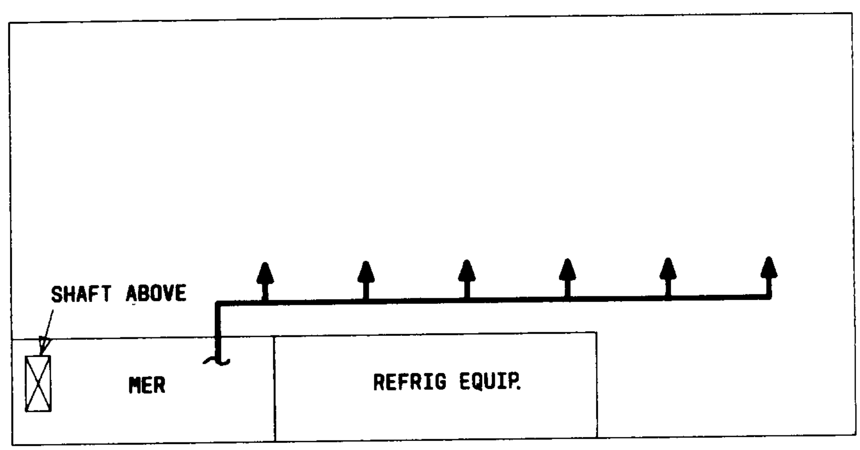


Fig. 7—High-Rise Office Building (Over Ten Floors) (Sheet 1 of 2)



PLAN

(TYPICAL FLOOR)



BASEMENT PLAN

Fig. 7—High-Rise Office Building (Over Ten Floors) (Sheet 2 of 2)