CABLE ENTRANCE FACILITY (CEF) BUILDING PLANNING AND PROVISION

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1. GENERAL

1.01 This Bell System Practice (BSP 760-200-030) provides standards for designing a new cable entrance facility (CEF) or enlarging an existing one. It is directed to engineering forces in the Real Estate Management organization engaged in:

(a) Planning—master planning and project planning

(b) Provision—real estate, design, and construction.

Engineers from Real Estate Management—in conjunction with the members of Distribution Service Planning Center (DSPC), Distribution Service Design Center (DSDC), Maintenance Center (MC), Construction Management Center (CMC), and other organizations—contribute to CEF planning. The Common Systems Planning and Engineering Center (CSPEC) coordinates the overall planning and engineering effort.

1.02 This BSP supersedes BSP 760-200-030 ***Cable Entrance Facility (CEF)*** (Issue 1, November 1977). Two companion documents cover the contribution made by CSPEC (BSP 781-800-005) and Distribution Service (BSP 919-240-610). Whenever this section is reissued, the reason for reissue will be listed in this paragraph.

1.03 Any specifications given in this BSP conform, as applicable, to standards set by:

(a) Network Equipment Building System (NEBS)

(b) National Fire Protection Association (NFPA)

(c) Occupational Safety and Health Act (OSHA)

1.04 Any local or state regulations and codes that are more restrictive than these standards should take precedence over them in designing the Cable Entrance Facility.

1.05 The CEF, previously called the "cable vault," is defined as the housing for the interface system that connects the outside plant network to the main distributing frame(s) in the central office (CO) building. This section provides planning and design information on the basic CEF systems. The designs include: (1) the above-surface system for small-to-medium central offices where the expense of a basement vault may not be warranted; (2) the subsurface system for medium-to-large central offices; and (3) a combination of the two basic systems, the duplex system, used for large high-rise buildings where distributing frames are located on upper floors as well as on the floor above the Cable Entrance Facility.

1.06 Each of the three general types of CEF serves as:

(a) A common entrance for feeder, trunk, and toll cables

(b) A protected interface with the outside plant environment

(c) A place where cable pressurization is introduced into the outside plant cable network

(d) A space for splicing feeder, riser, and terminating connector stub cables.

1.07 CEF systems developed from the basic designs listed in the preceding paragraph will vary to meet the needs of specific COs and local requirements. However, the requirements presented in this BSP will govern CEF designs to promote standardization throughout the Bell System. This BSP provides an overall description of the factors that the Building Planner and Building Project Manager must consider in planning and designing a new CEF.

1.08 The process of selecting the type of CEF system for any given building should be handled by CSPEC during the planning phase after the wire center study is completed. A CEF racking and splicing design can then be developed by CSPEC and Distribution Services, and plans for its implementation formulated. The Real Estate Management organization prepares the building study plans and later the architectural drawings, based on CSPEC and building design considerations (Fig 1). Building design considerations include work area space requirements, access-egress, lighting, environment, gas protection, electrical requirements, fire protection, and security.

2. PLANNING FUNCTIONS

2.01 Under the Total Network Operations Plan (TNOP), specialized information is collected by CSPEC. Information from the Wire Center Planning Center (WCPC) gives the number of lines, stations, and trunks proposed for the life of the wire center. These requirements and data from other centers are the input that initiates the Real Estate Management processes leading from location selection to building construction.

3. CEF DESIGN PLANNING

3.01 Under TNOP integration, CSPEC initiates CEF planning as soon as a central office addition or new wire center building is anticipated. On completion of site selection by Real Estate Management and long-range forecasting by the WCPC, CSPEC receives duct requirements from Distribution Services; then develops racking plan requirements. CSPEC presents these requirements to the Real Estate Management organization for preparation of building study plans.

3.02 The Real Estate Management organization, composed of Planning, Provision, and Operations sections, is responsible for building construction and operation. The cable entrance facility is an integral part of the building it serves, and its

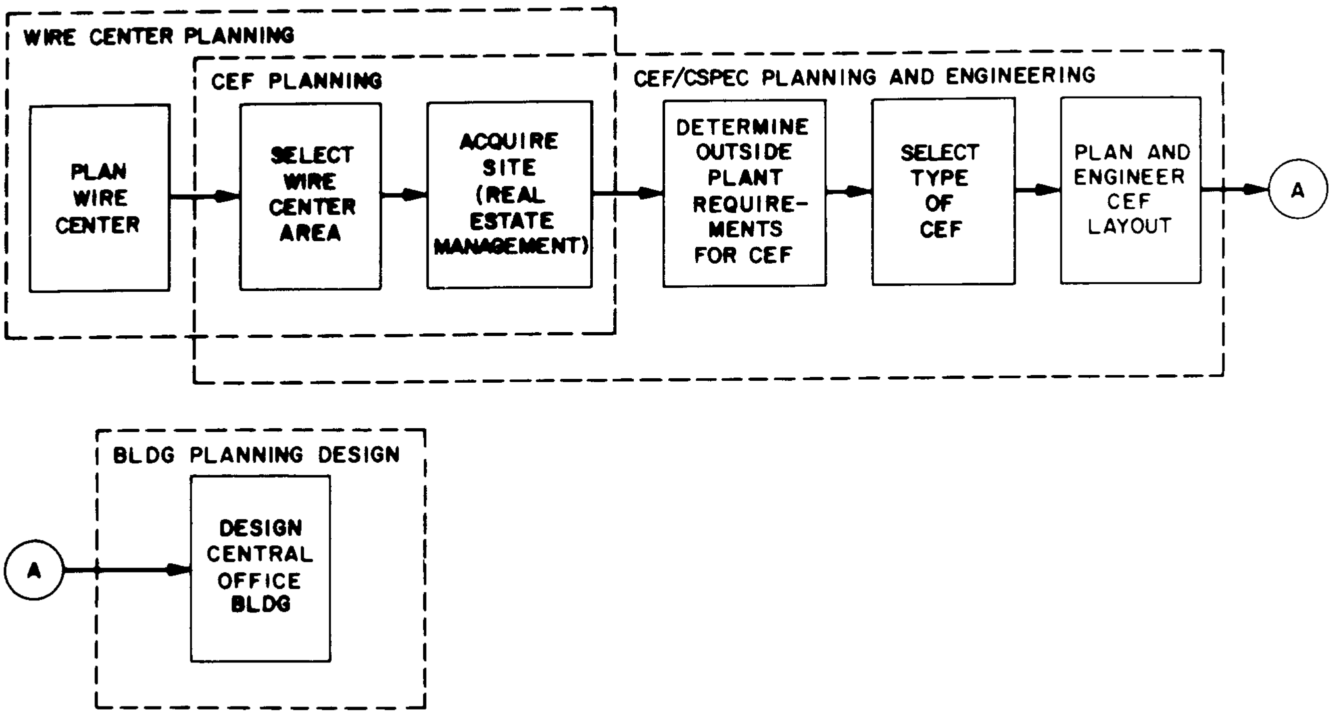


Fig 1—CEF Planning and Design Flow

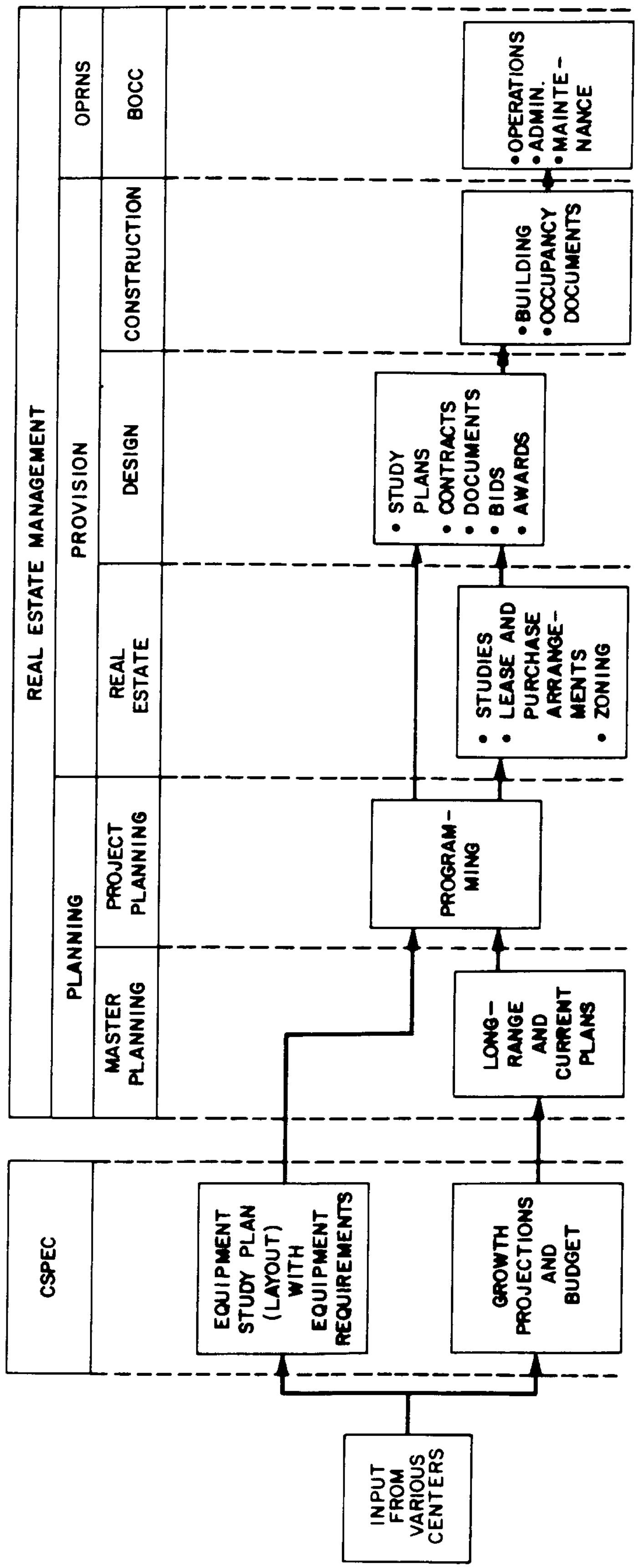


Fig 2—Real Estate Management Organization Flow

design and construction must be managed as part of the integrated facility. When information on the facility is received from CSPEC, the Building Planner analyzes this information and transmits it to the Building Project Manager, as drawings and written requirements (often called "study plans"). The Building Project Manager translates the requirements into construction documents from which the building and the CEF are built. Upon completion, the building is inspected and released to Building Operations forces for administration and maintenance. At this point the structure is ready for equipment installation. The Real Estate Management flow is shown in Fig 2.

3.03 The Real Estate Management organization is also responsible for various planning activities, including:

(a) ***Location selection.*** Working with information supplied by CSPEC, the Real Estate Manager identifies and evaluates various tentative locations in the vicinity required for a new wire center.

(b) ***Site selection.*** After evaluating tentative locations the Real Estate Manager selects a site that meets the parameters for the wire center.

(c) ***Preliminary construction cost.*** Concurrent with the site selection, the Building Project Manager develops estimated construction costs for each tentative site.

(d) ***Building planning.*** Working with CSPEC, the Building Planner develops floor plan layouts providing for equipment, Distribution Service requirements, and building expansion.

(e) ***Soil investigation.*** The Building Project Manager investigates the site for soil conditions, load capacity, water condition, and other utility considerations.

(f) ***Zoning, rights of way, title.*** The Real Estate Manager and the Building Project Manager investigate the selected property for legal restrictions, zoning requirements, encumbrances, and easements. In addition the Real Estate Manager is responsible for obtaining clear title to the property.

Additional information on the planning process is contained in BSP 760-100-010.

CABLE ENTRANCE FACILITY PLANNING

3.04 Cable entrance facility planning is integral with building planning. It is based on information and requirements received from CSPEC, NEBS requirements, the limitations of the site, and construction costs.

SIZE AND TYPE OF CEF

3.05 The size and type of the CEF depend upon the Distribution Service plan and the equipment to be installed. The choice between an above-surface and subsurface CEF design should be based on a thorough evaluation of the economics, the number and complexity of existing cable feeder routes, the functions to be served, the ultimate number of outside plant terminations, as well as the location of the wire center, its future role in central office area expansions, and the need for a basement for other building systems.

3.06 The CEF may be located below the grade level of the central office building. This type of CEF is called "subsurface." A CEF located above the grade is called "above surface." A combination of the two types is called "duplex." The following are recommendations for choosing the CEF type:

(a) The subsurface CEF is recommended for all central offices requiring more than 20 conduits. A subsurface CEF's splicing frame structures are located below the distributing frame, either as a self-contained space ("cable vault") or as part of the central office's basement. It should be designed with outside plant cables entering through one or both end walls.

(b) The above-surface CEF is feasible in situations where the soil is adverse (eg, rocky) or the water table is high.

(c) The duplex CEF is the Bell System standard for all multistory central office buildings, where several distributing frames are located on more than one floor.

(d) The duplex CEF is also standard for all central offices that use the Common System Main Interconnecting frame system (COSMIC); for example, the COSMIC II Subscriber Main Distributing Frame system (SMDF).

3.07 Once the type of CEF system has been selected, its detailed design requirements can be determined. Whenever possible, the CEF design should be consistent with the building Engineering Standards for Network Equipment Building System (NEBS) standards, developed for central office buildings. Aisle and work space allocations should be consistent with human factor and work-function requirements and OSHA standards. CEF space planning must consider those future CEF expansions which are to be coincident with main frame and CO equipment growth allocations. Local preferences and conditions must also be evaluated for total impact before accepting a standard CEF design.

LOCATION AND SIZE OF CEF

3.08 A subsurface CEF should be located adjacent to an exterior foundation wall, directly below the protector or distributing frame. However, in some cases the location of the distributing frame within the equipment area will dictate locating the subsurface CEF away from an exterior wall. An above-surface CEF can be located on the same level directly adjacent to the distributing frame area. It should also be located along an exterior wall parallel to the distributing frame line-up. The design should provide adequate space for cable conditioning, pressure plug and ground. The length of the CEF should not be less than that of the protector or distributing frame.

3.09 Frame layouts must take into account the additional space required from the conduit end-wall terminations to the first frame vertical position. In most offices, this floor space dimension is 12 to 15 feet. Within the CEF, this space is utilized for routing the feeder cables to their assigned support levels, making air pressure cable connections, and implementing electrical and corrosion protection measures.

3.10 More than one cable framing structure may be required in wire centers equipped with double frame line-ups or high density frames, such as the double-sided protector frame. Multi-cable framing structures may also be needed in buildings that contain several frames located directly above the CEF on upper floors. The subsurface portion of the CEF should be used primarily for feeder-to-riser cable splicing and riser cable routing to upper floors. This type of CEF system has been designated a "duplex."

BUILDING EXPANSIONS AND CONVERSIONS

3.11 The CSPEC CEF planner should recognize the possibility of future building expansions and equipment conversions when selecting a splicing frame. If expansion or conversion plans exist, the splicing frame should incorporate features which will facilitate CEF expansion. Building space planners should consider potential CEF expansion to ensure a minimal economic penalty.

4. CABLE ENTRANCE FACILITY DESIGNS

4.01 This part presents several typical CEF designs which can be used to satisfy the requirements of offices designed according to NEBS standards. CEF design, in conjunction with the selection of an appropriate racking and splicing design, must also satisfy the requirements for space planning, safety, fire protection, security, cable protection, cable routing and racking, cable placement, conduit, and terminations.

ABOVE-SURFACE CEF DESIGNS

4.02 *General.* The above-surface CEF system can have cables and splice closures secured either along the exterior building wall of the central office, or on a metal cable framing structure with work aisles located on both sides paralleling the protector or distributing frame. Fig 3 shows an example of a floor plan of the above-surface CEF in relation to the main frame and switching equipment. Note that the CEF can be expanded as required in the direction of equipment and MDF growth.

4.03 The *two* basic conduit entrance and cable racking design options for the above-surface CEF are:

- ***Vertical-entry/vertical-splicing design*** with cables entering the CEF vertically through the floor at the base of one of the exterior building walls, and with splice closures secured ***vertically*** on a wall-mounted framing structure (Fig 5).

- ***Conventional horizontal-entry/horizontal-splicing design.*** Fig 4 shows an example of cable entering the CEF horizontally for a horizontal-splicing arrangement.

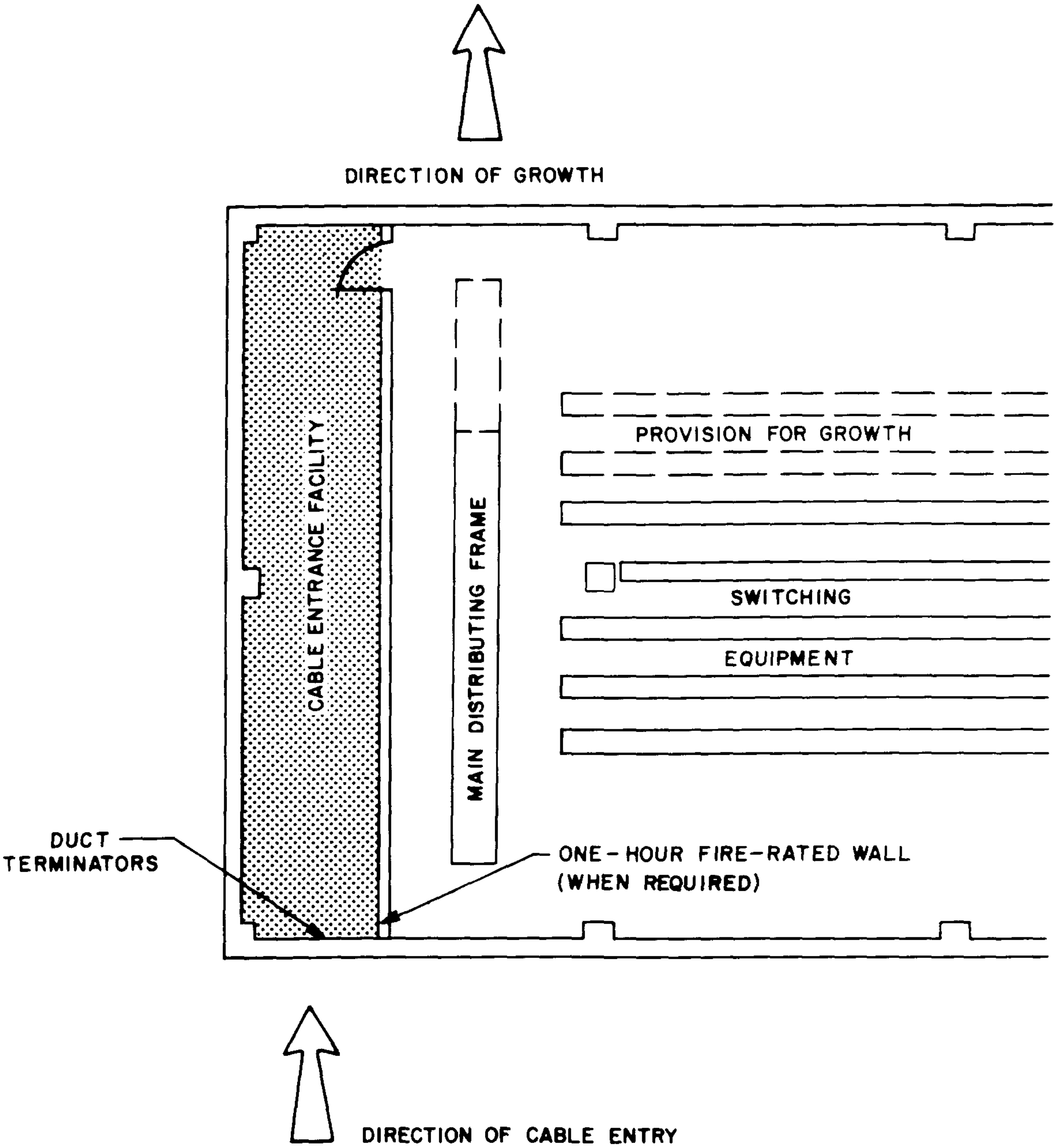


Fig 3—Typical Layout of Above-Surface CEF

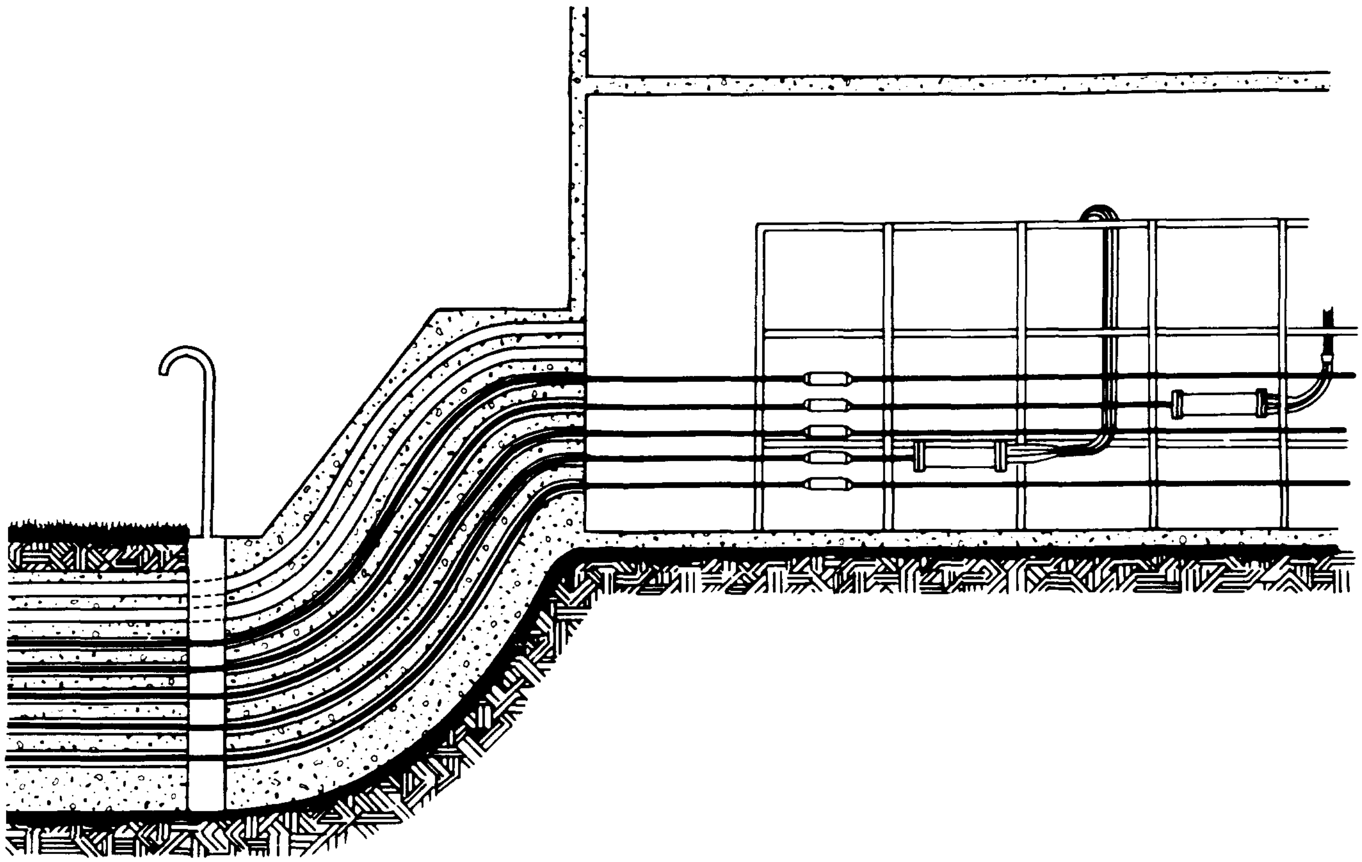


Fig 4—Above-Surface CEF with Horizontal-Entry/Horizontal-Splicing

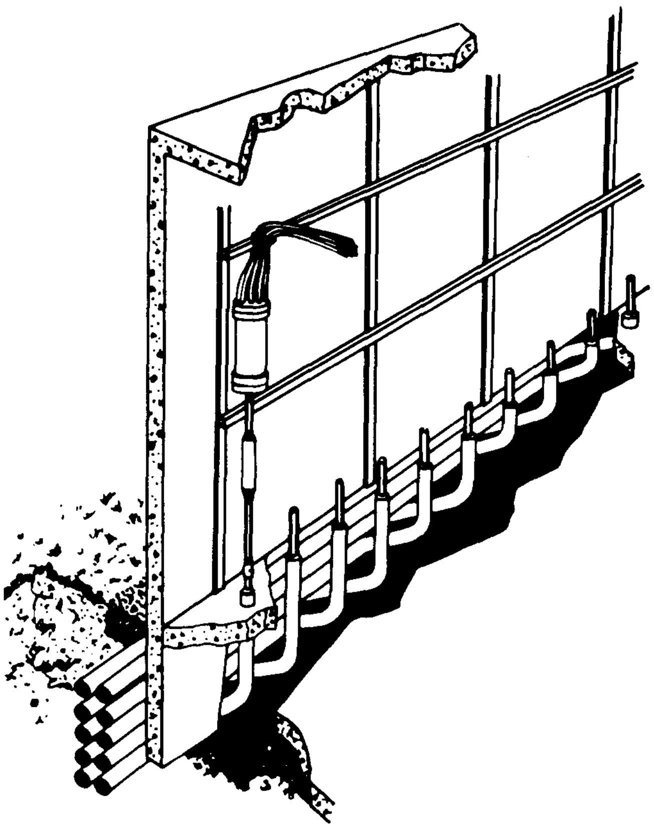


Fig 5—Vertical-Entry/Vertical-Splicing with Wall-Mounted Frame

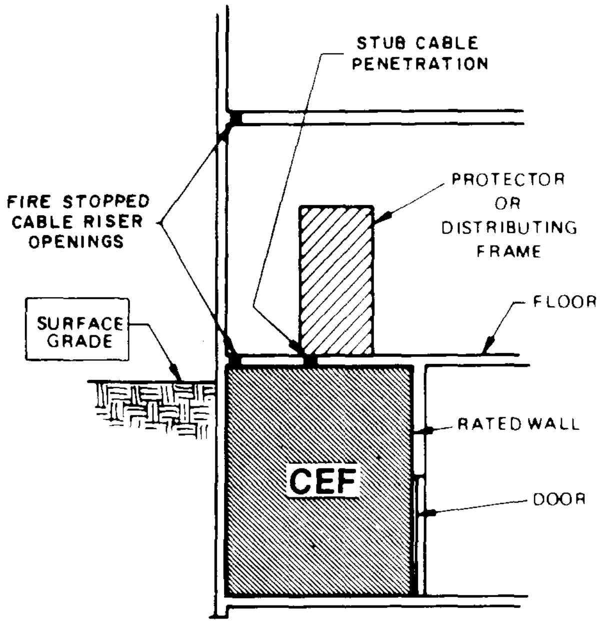


Fig 6a—Subsurface CEF, Enclosed

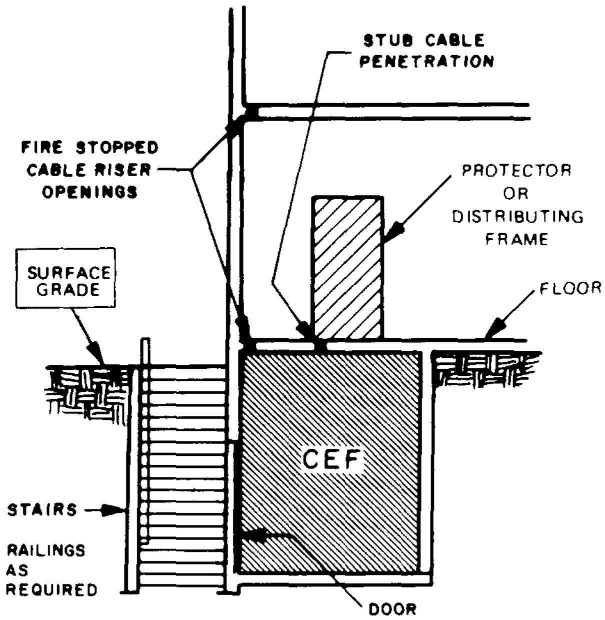


Fig 6b—Subsurface CEF, Self-Contained

4.04 ***Vertical-Entry/Vertical-Splicing Design.*** Vertical-entry/vertical-splicing is suitable for central offices with no more than 20 conduit terminations, from any single underground manhole (to avoid congestion). Fig 7 illustrates the layout of a vertically racked above-surface design with floor-terminated conduits spaced one foot on-centers within each 40-inch splicing bay. With this termination pattern the standard 20-foot building bay can accommodate 16 conduit terminations. Spacing between conduits will vary and must be based on the frame fill requirements and the estimated average size of cables for the wire center. The cables are secured vertically along the exterior wall and spliced to connector stub cables.

SUBSURFACE CEF DESIGNS

4.05 ***General.*** A subsurface CEF system has cables and splice closures racked and routed on a cable support frame located below normal grade level in a space that may be enclosed by walls or partitions (Fig 6a). Subsurface CEFs can be located in the CO basement but may be self-contained, with protector or distributing frame normally positioned on a floor directly above the CEF. (See Fig 6b.)

4.06 The subsurface CEF is usually designed with outside plant cables entering through one or both end walls. The number of work aisles and cable support frames is determined by the number of enter-

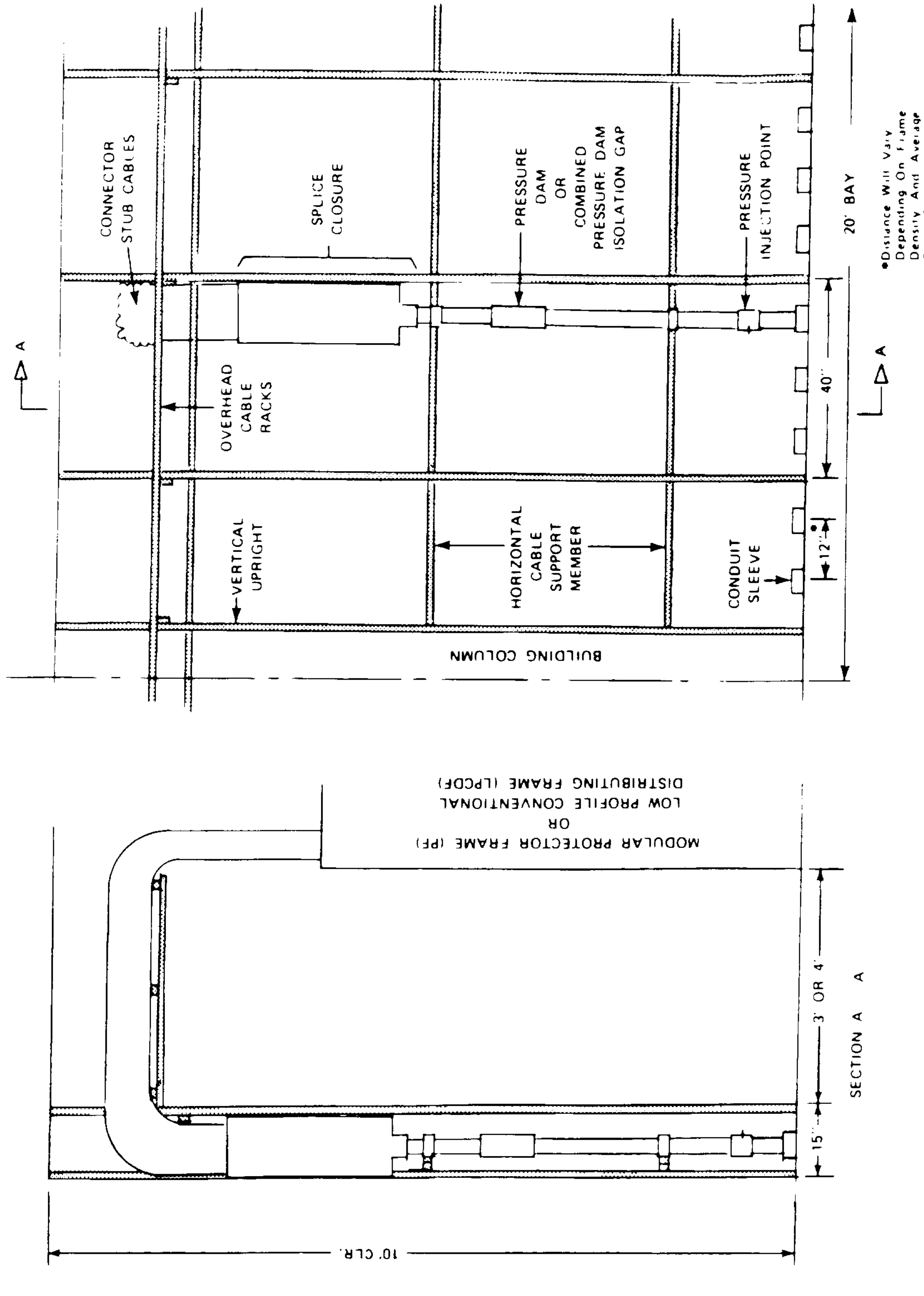


Fig 7—Above-Surface Layout for Vertical-Entry/Vertical-Splicing

ing conduits; a multi-aisle CEF requires adequate access to and from each aisle and an emergency exit.

4.07 Two basic cable racking designs are available for a subsurface CEF system:

- ***Horizontal-entry/horizontal-splicing (horizontal) design***
- ***Duplex arrangement***—cables enter horizontally and are directed vertically then terminated on the same floor as the distributing frame.

4.08 ***Horizontal Design.*** In horizontal design the feeder cables enter the CEF area horizontally, as shown in the previous horizontal entry designs. The feeder cables are supported on horizontal support arms which can accommodate up to 3 cables per side per level. Fig 8 shows the basic layout for horizontal design. There is a 9-inch spacing between support arms on the cable racking side of the vertical framing members, and an 18-inch spacing between arms on the closure side.

4.09 The two vertical members that are used to support the horizontal cable support arms form the splicing or cable routing bays. Alternate bays are used for splicing and routing connector stub cables. The cable routing bay is sectionalized into two areas by a stub cable support bar. This bar provides a securing position for the stub cables routed to the cable spreading rack, and a routing space for transit of feeder cables to the adjacent splice closure bay.

DESIGNS FOR DUPLEX OR AUXILIARY (ACEF) CEF SYSTEMS

4.10 ***General.*** The duplex CEF system combines several design features of both the above-surface and subsurface CEF systems. A duplex system is employed whenever several terminating frames are required on more than one level in the same central office building (Fig 9). This is always used for COSMIC II frames.

4.11 The duplex system, consisting of a subsurface CEF and above-surface ACEF is the most economical interface between the loop feeder cable and connector stub cables. It is recommended for all DF systems which are remote (by one floor or more) from the CEF. It is the only recommended interface for the COSMIC II frame systems and for conventional frames with 60 or more verticals that require cable spreading.

AUXILIARY CEF (ACEF)

4.12 Sufficient space in the distributing frame (DF) area should be allocated for the construction of an ACEF for splicing tip cables to the outside plant cables. An ACEF arrangement with vertical splicing has the advantage of using floor space between the building columns on an outside wall in the DF area. (See Fig 9.)

4.13 ***Duplex—Flooding Areas.*** In areas where flooding or a high groundwater table is prevalent and the basic above-surface CEF is not sufficient, a subsurface CEF can be added to the above-surface CEF to form a modified duplex as illustrated in Fig 10.

4.14 The subsurface area of the modified duplex is used for terminating the conduit formation and for routing the feeder cables to selected riser sleeve openings connected to the above-surface area. The above-surface portion serves as a splicing area to connect the feeder cable to the connector stub cables (in the vertical position). It also provides space for performing all necessary cable protection measures.

SIMPLE SWEEP-IN ENTRANCE

4.15 For small offices using six or fewer conduits, with extremely low growth forecast over the full planning interval, the simple sweep-in entrance illustrated in Fig 11 is adequate.

CABLE SUPPORT FRAMING STRUCTURE

4.16 The most appropriate type of cable support framing structure will vary in accordance with the type of CEF—from wall-mounted framing structures for rural central offices to multiframe structures for large metropolitan wire centers. A metal framing structure should be used to support CEF cables. A pre-formed framing structure is recommended as the most flexible method of providing for present and future requirements in the CEF. A metal framing structure should comply with the standards of the National Electrical Manufacturers Association (NEMA). See BSPs 622-700-100 and 622-700-200.

CABLE OPENINGS

4.17 ***General.*** In the completed CEF construction drawings, Building Planning and Design must show the placement of holes (shafts, sleeves, or conduits) and modular closures to accommodate risers.

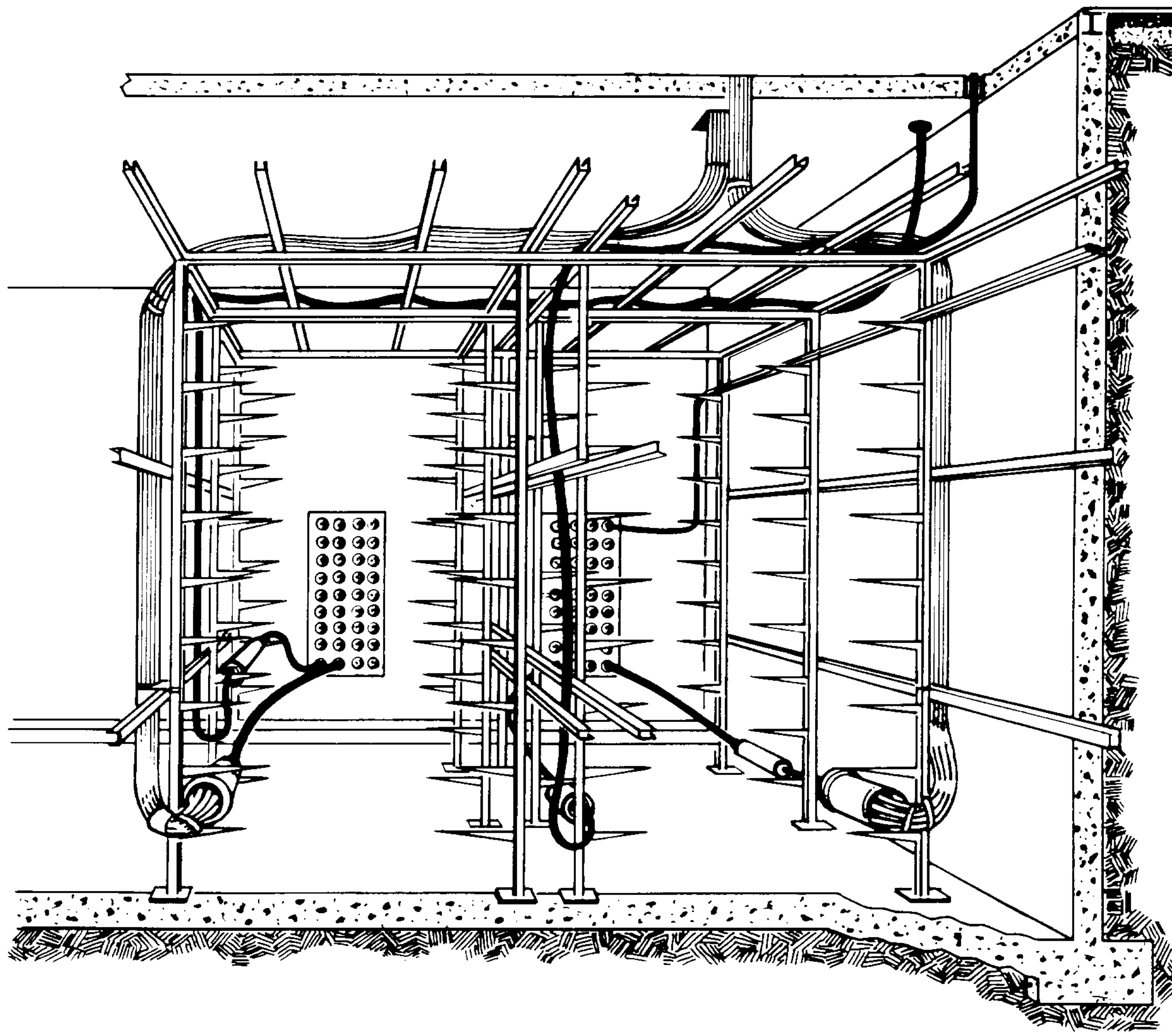


Fig 8— Horizontal Design

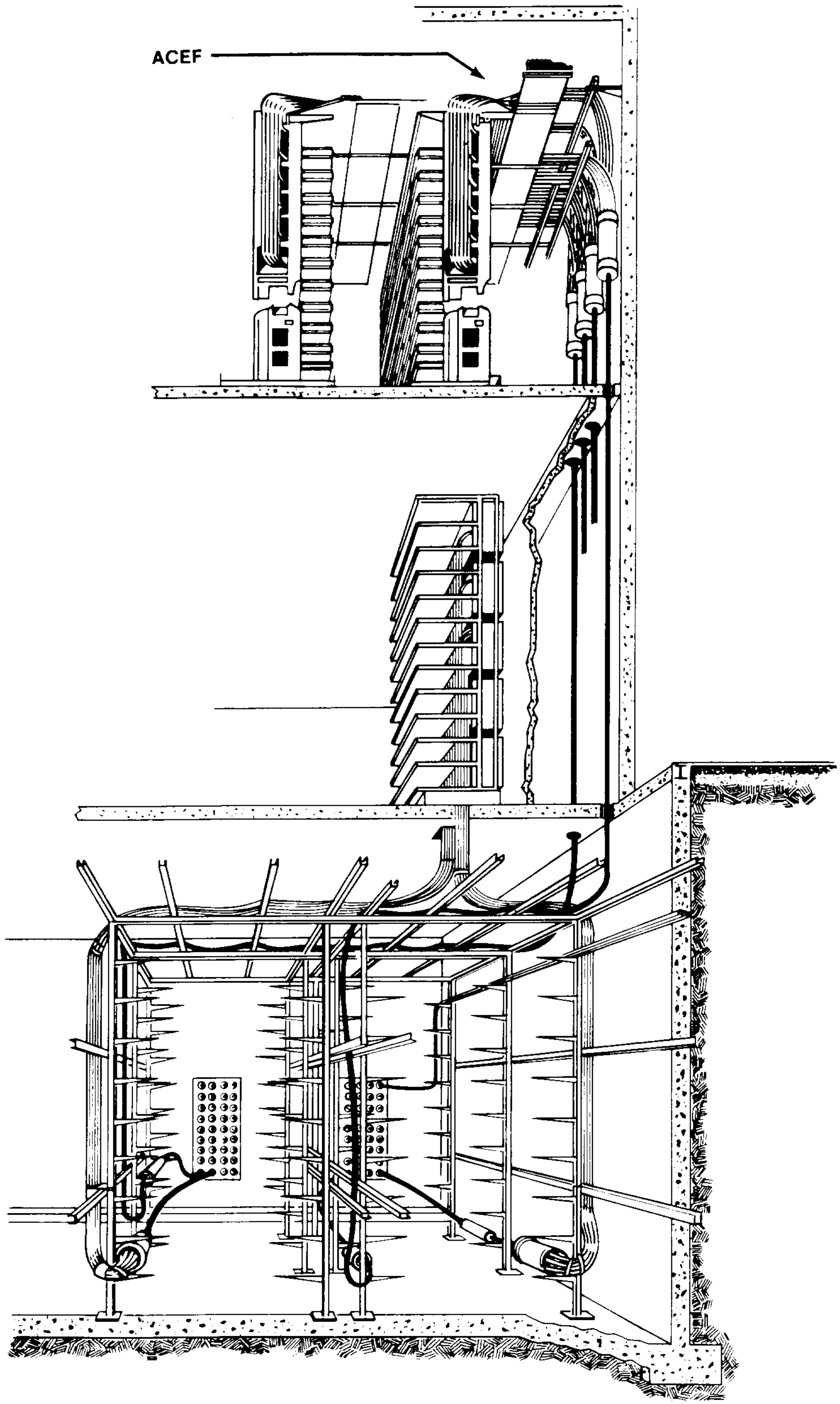


Fig 9—Duplex CEF Design

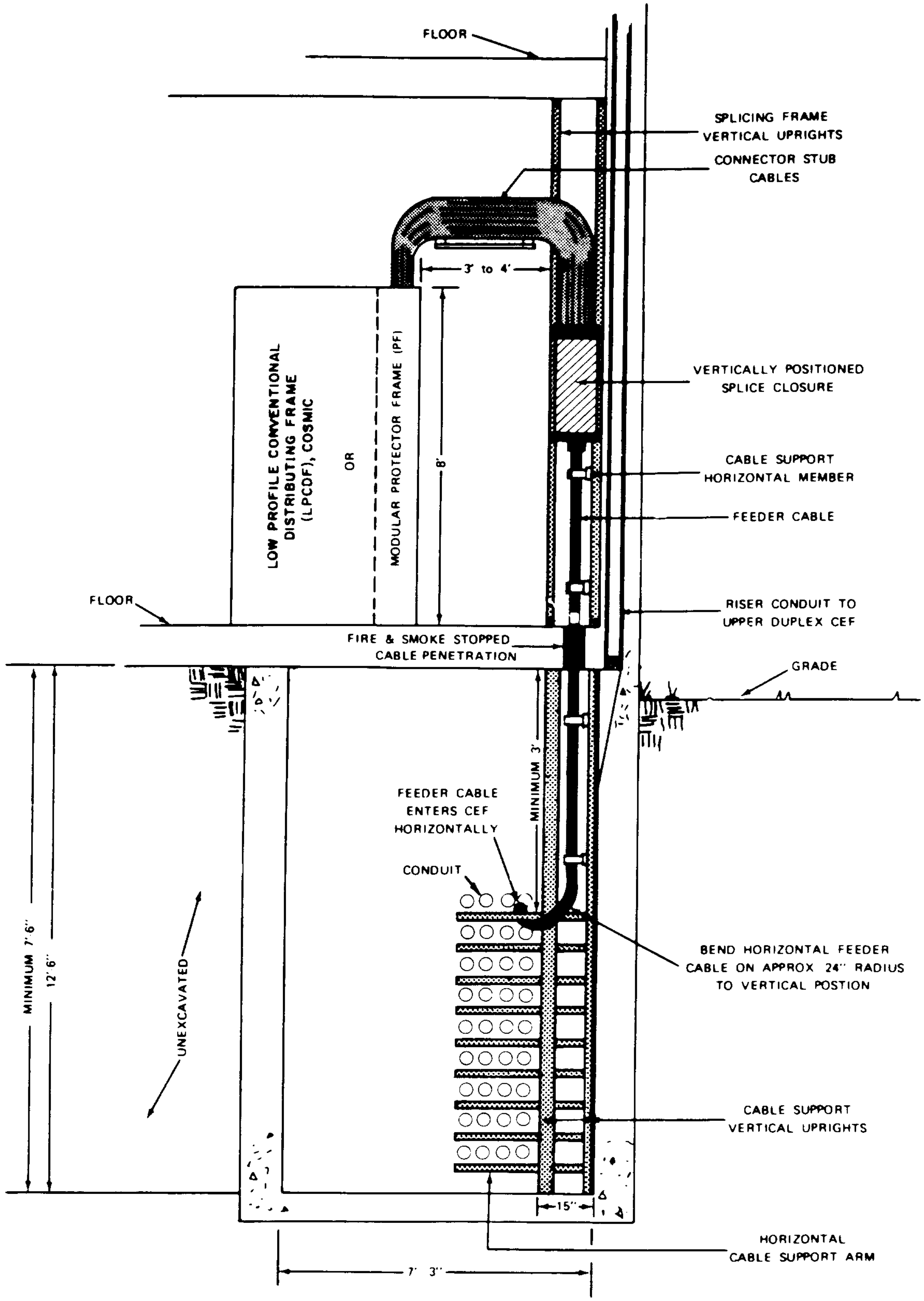


Fig 10—Duplex CEF—Modified Design for Use in Flood-Risk Areas

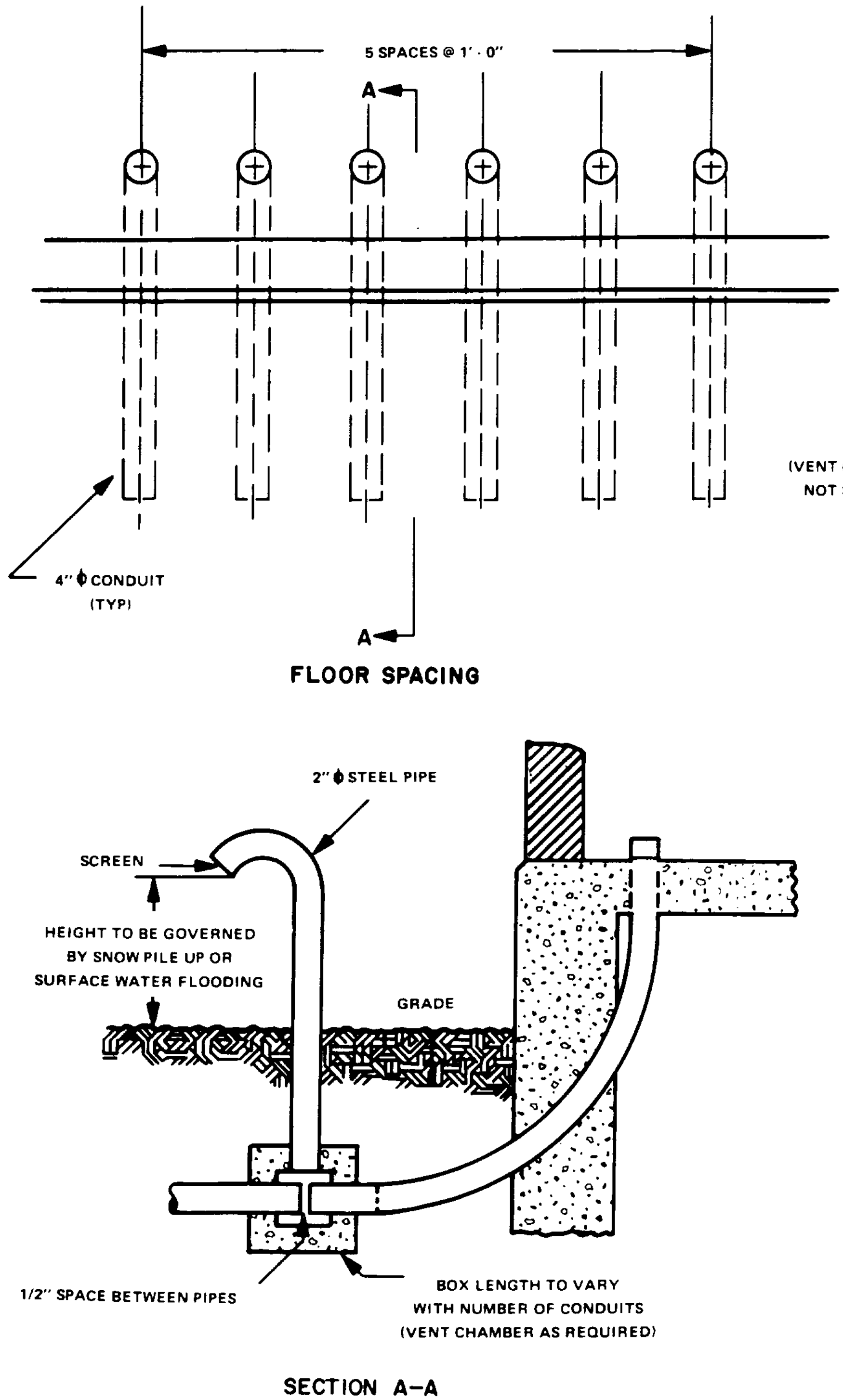


Fig 11—Simple Sweep-In Entrance

In addition to the requirements of BSP 800-610-164, ***Network Equipment Building System (NEBS), General Equipment Requirements***, information contained in these drawings must conform to the requirements of BSP 760-200-031, ***CEF Conduit Entrances, Holes, and Risers***, BSP 760-200-032, ***Cable Openings, Design Standards***, and BSP 800-614-153, ***Sheathing for Cable Openings***.

FEEDING HOLES AND PULLING-IN HARDWARE

4.18 The CEF design should include the locations of feeding holes and pulling-in hardware. These items should be designed and installed to handle the cable requirements of the CEF as prescribed by CSPEC.

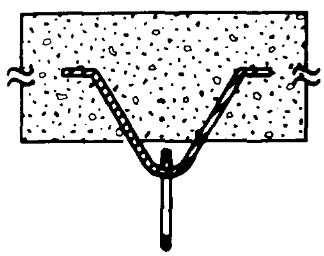


Fig 12—Pulling-In Iron with Ring

4.19 ***Pulling-In Irons.*** Depending on local options and needs, cable pulling-in irons can be placed either above and below each horizontal-entry conduit terminating formation and/or in the floor and ceiling of the CEF. In any case they should be placed to allow the positioning of the pulling line and cable into any conduit with the type of pulling-in hardware used in the area. Drawings should show floor- and ceiling-mounted pulling-in irons or rings for placing cable in vertically terminated conduits and for riser pathways. Drawings should also indicate pulling-in hardware in the ceiling of the riser terminating floor for raising and lowering riser cables. Pulling-in hardware must be designed for a minimum tension capacity of 2000 pounds.

Pulling-in iron—a metal "U" bracket secured in the building structure to resist tension caused by pulling cable.

Pulling-in ring—a closed metal ring attached to a pulling-in iron. (See Fig 12.)

4.20 ***Feeding Holes.*** A cable feeding hole of 8 to 10 inches in diameter should be provided at the end wall of each horizontal-entry cable placing alley, to accommodate the pulling line and/or the cables being fed into the CEF. CEFs with vertically terminated conduits can be served with either cylindrical feed holes or rectangular hatches strategically located above the cable splicing area. Cable feeding holes should not be located within 3 feet of the nearest conduit termination. The holes should be equipped with metal covers which will provide protection against vandalism and prohibit the passage of liquids. Covers must be constructed so that they can be secured from within the CEF.

4.21 The exterior entrance to the cable feeding holes should be located to permit a cable trailer or a line truck to feed cable into the holes. (See Fig 13a for round hole and Fig 13b for rectangular hole.)

5. BUILDING DESIGN CONSIDERATIONS

CEF HEIGHT AND LOAD ALLOCATIONS

5.01 All equipment designed for the CEF shall be compatible with the spatial requirements of the CO (ie, 10-ft clear height for equipment and associated cabling and 12 ft, 6 in. to the lowest building structural member). When packaged for transit and accompanied, or supported, by the usual handling facilities, any such equipment that may be required to enter a CO building without special access shall be within the standard building entrance dimensions (4 ft wide by 8 ft high).

5.02 CEF equipment shall have a maximum floor load of 140-lb/ft^2. This is applicable to floor-supported equipment, and is determined by totalling the weight of all such equipment in the area, including cable, splice cases, racks, etc., and dividing by the associated floor area. The total weight may be averaged over the entire cable entrance area, including aisles and personnel work areas. The weight of all such equipment shall be supported by the floor. Ceiling attachments shall be limited to lateral bracing. The floor design must also include 10-lb/ft^2 for personnel and transient loads for a total design load of 150-lb/ft^2.

5.03 Wall-supported CEF equipment shall have a 75-lb/ft^2 maximum weight allowance. The uniform weight allocation, which is applicable to wall-supported equipment, is the total weight of all such equipment divided by the surface area of the associated wall. The total weight may be averaged over the total surface of the wall height (floor to ceiling), but only over the length of the wall to which the equipment or cable is actually attached. Further, the center of gravity of any such wall-supported equipment shall be 16 in. or less from the surface of the wall, or the 75-lb/ft^2 weight allocation shall be decreased proportionately.

WORK AREA SPACE REQUIREMENTS

5.04 ***General.*** The CEF must include adequate space for efficient and safe handling of equipment. Entrance and exit must satisfy the National Fire Protection Association (NFPA), Occupational Safety and Health Act (OSHA) requirements, and local regulations. The safety and health of personnel who occupy the CEF are important considerations in the design of the facility. Design considerations include work clearances, aisle dimensions, means of entrance and exit, travel within the CEF, the environment, gas and fire protection, and security. Factors to be considered in calculating space requirements are:

- Sizes of platforms, ladders and scaffolds
- Physical dimensions and weight of equipment utilized on floors, scaffolds, etc.
- Equipment mobility requirements
- Space required for secondary support systems for equipment, (eg, electricity, air pressure).
- Size and reach of human occupants
- Most comfortable and productive work positions.

5.05 ***Work Clearances.*** Cable splicing will be performed in various horizontal and vertical locations in the CEF, so the splices will need adjustable platforms or scaffolds. Adequate clearances (overhead, vertical and horizontal) must also be provided for the splicer to work effectively at all positions of

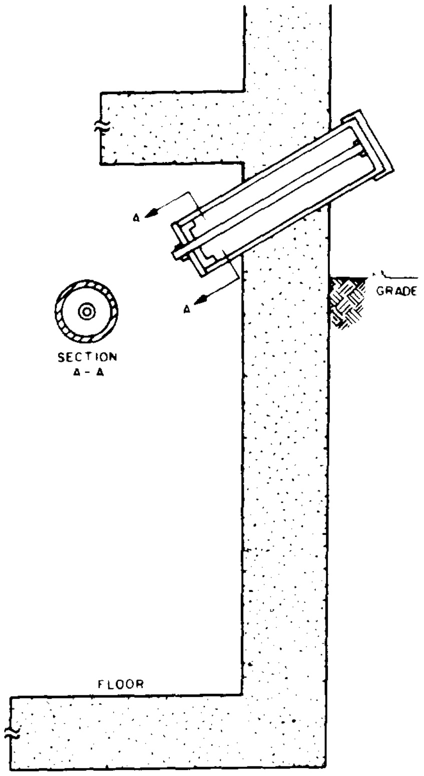


Fig 13a—Cable Feeding Hole (Round)

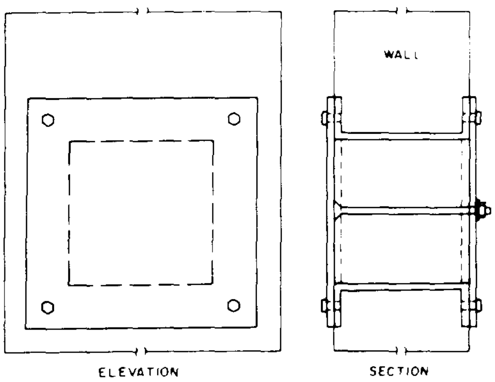


Fig 13b—Cable Feeding Hole (Rectangular)

the cable racking structure. The minimum recommended clearances for splicing operations are:

overhead clearance—32 inches is recommended

horizontal splice—25 inches above the floor (can be a temporary position used only for splicing)

vertical splice—limited by space required to position cable, closure, and supporting structure (minimum of 12 inches between splice closures).

5.06 *Aisle Dimensions.* Aisles should be large enough for free and clear passage. Equipment such as cable support hooks and frame supports should not block aisles. The recommended aisle width for the CEF is 4 feet. The minimum is 3 feet.

ENTRANCES AND EXITS

5.07 *Entrance and Exit.* Access to the CEF will depend on the location of the CEF and its size and type. The exit must accommodate mobile people, tools, and equipment. It must also provide safe passage for immobile people. The table below shows the recommended means of access.

RECOMMENDED CEF ACCESS

TYPE OF CEF	MEANS OF ACCESS
above-surface, adjacent to CO equipment	horizontal entry
subsurface, adjacent to occupied space	horizontal entry
subsurface, below occupied space (Horizontal entry cannot be provided from an adjacent building space.)	fixed stair-ladder or fixed stairs at the angle of ascent shown in Fig 14

Relative advantages of the various means are shown in Table A.

5.08 ***Two primary means of access to subsurface CEFs where horizontal access is impossible are: fixed stair-ladders or fixed stairs.*** A recommended secondary means of egress can also be provided by means of fixed straight ladders. All means of egress shall be incorporated permanently into the equipment or building framework. Fixed straight ladders must be used with one of the primary means.

An enclosed passageway is defined as one that is sealed off from the adjacent spaces by partitions which must be entered through doors or hatches located at one or both ends of the partitioned passageway. An unenclosed passageway is defined as one which has only a door or hatch at the exit, and which is not partitioned from the adjacent work spaces or floors.

5.09 *Order of Desirability.* Assuming that a horizontal accessway cannot be provided, the following is the ranking of alternative access and egress facilities in order of desirability:

1. Fixed stairs for personnel access and a separate protected opening for apparatus access with winch provisions.

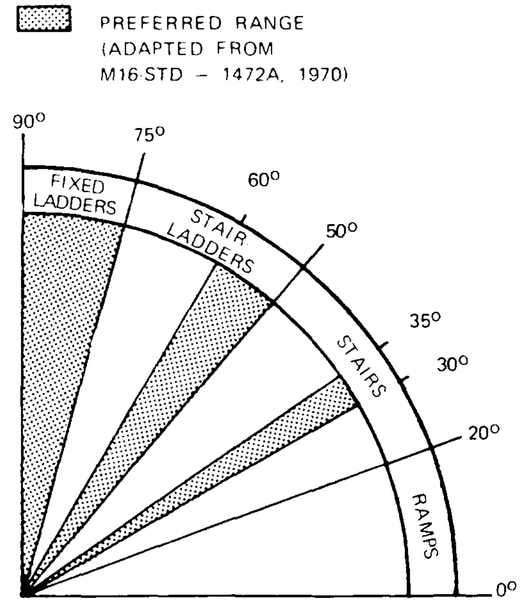


Fig 14—Ascent Angles of Ladders, Stairs, and Ramps

2. Fixed stairs for personnel access combined with an apparatus-access opening and winch.

3. Fixed stair-ladder for personnel access and a separate opening with winch for apparatus access.

4. Fixed stair-ladder for personnel access and combined apparatus-opening with winch for equipment access.

Means of access will also be influenced by the cost of installation and associated space costs.

TABLE A

MEANS OF ACCESS IN CEF (COMPARISON)

Means of Access and Angle of Installation	Advantages	Disadvantages
Fixed Stairs: between 30 and 35 degrees to the horizontal. For dimensions see Fig 15.	• Safe for one person to hand-carry items weighing less than 25 lbs. • An injured person can be rescued by two people using a stretcher • Workers with minor injuries can exit with minimal help	• A larger floor opening is required for fixed stairs than for a stair-ladder or a straight ladder • An additional opening may be needed for winches.
Fixed Stair-Ladders: between 50 and 60 degrees to the horizontal. For dimensions see Fig 16.	• Safe for one person to hand-carry less than 10 lbs. • An injured person can be rescued without a winch and line • Workers with minor injuries can exit by themselves.	• A larger floor opening is required for a fixed stair-ladder than for a straight ladder especially if bulky objects will be passed through with a winch • More floor space is required at the foot of the ladder.
Fixed Straight Ladders: between 75 and 90 degrees to the horizontal. For dimensions see Fig 17.	• Small opening in ceiling is required • There will be minimal protrusion into area below opening.	• Dangerous climbing when equipment is hand-carried; need a hand-line or similar device • Difficult for an injured person to exit unaided.

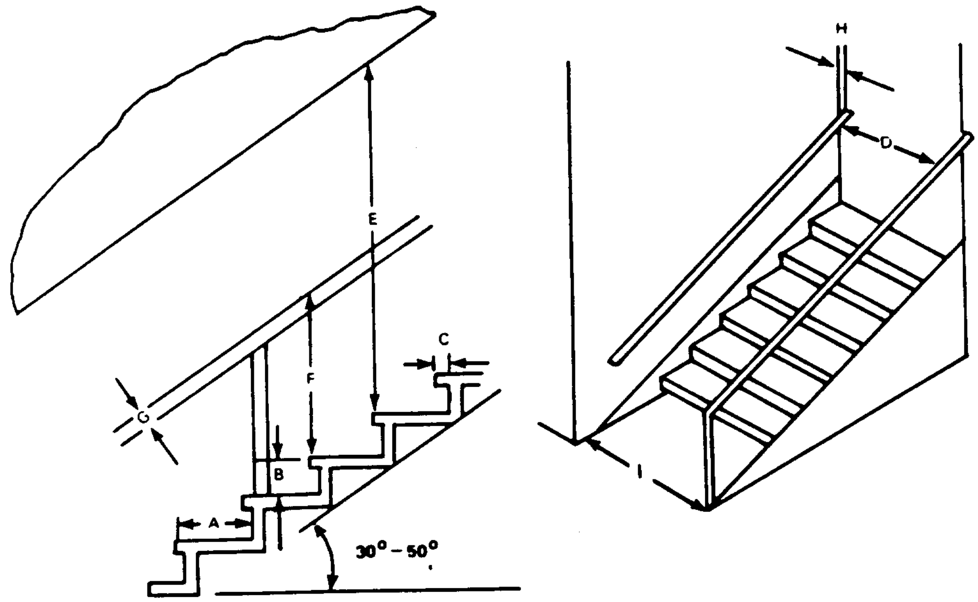
5.10 *Protection for Ladders and Stairways.* Every stairway floor opening must be guarded by a standard railing. For pipe railings, posts, top, and intermediate railing must be at least 1-1/2 inches in diameter. Railings should be provided on all exposed sides except the stairway entrance. For infrequently used stairways where traffic across the opening prevents the use of fixed standard railings (eg, when located in aisle spaces), a hinged floor opening cover should be provided. This cover should have removable standard railings on all exposed sides except at the stairway entrance.

5.11 *Floor Openings.* Each floor opening for a ladder shall be guarded by a standard railing with standard toeboard on all exposed sides (except at the stairway entrance), a swinging gate, or similar mechanism, so a person does not walk into the opening. When doors or gates open directly on a stairway, a platform must be provided. This platform should be at least 20 inches in width beyond the door's swing.

5.12 *Standard Railings.* Standard railings shall consist of a top rail, intermediate rail, and posts, and shall have a vertical height of 42 inches nominal from upper surface of top rail to floor.

5.13 *Toeboards.* Toeboards must be installed to retain loose equipment or materials which might strike persons working below, on stairs or ladders, etc. The standard toeboard shall be 4 inches nominal in vertical height from its top edge to the level of the floor. It shall be securely fastened in place and should have no more than 1/4-inch clearance above floor level. Toeboards should be securely fastened and made of a solid material with no openings larger than one inch in diameter.

5.14 *Travel Distance within the CEF.* The travel distance from any point in the CEF (including aisles) to the nearest exit shall be 200 feet or less. (Obey local fire or building codes when they are more restrictive.)



	DIMENSION	MINIMUM	MAXIMUM	RECOMMENDED
A	Tread run* (including nosing)	8.00"	11.00"	Note "A"
B	Riser height	6.50"	9.50"	Note "A"
C	Depth of nosing	0.75"	1.50"	1.00"
D	Width (handrail to handrail):			
	One-way stairs	30.00"	. . .	36.00"
	Two-way stairs	48.00"	. . .	51.00"
E	Vertical clearance	84.00"	. . .	84.00"
F	Height of handrail (from leading edge of tread)	30.00"	34.00"	33.00"
G	Handrail diameter**	1.50"	3.00"	1.50"
H	Rail clearance from wall	1.50"	. . .	3.00"
I	Width of stair	22.00"	∠88.00"	44.00"

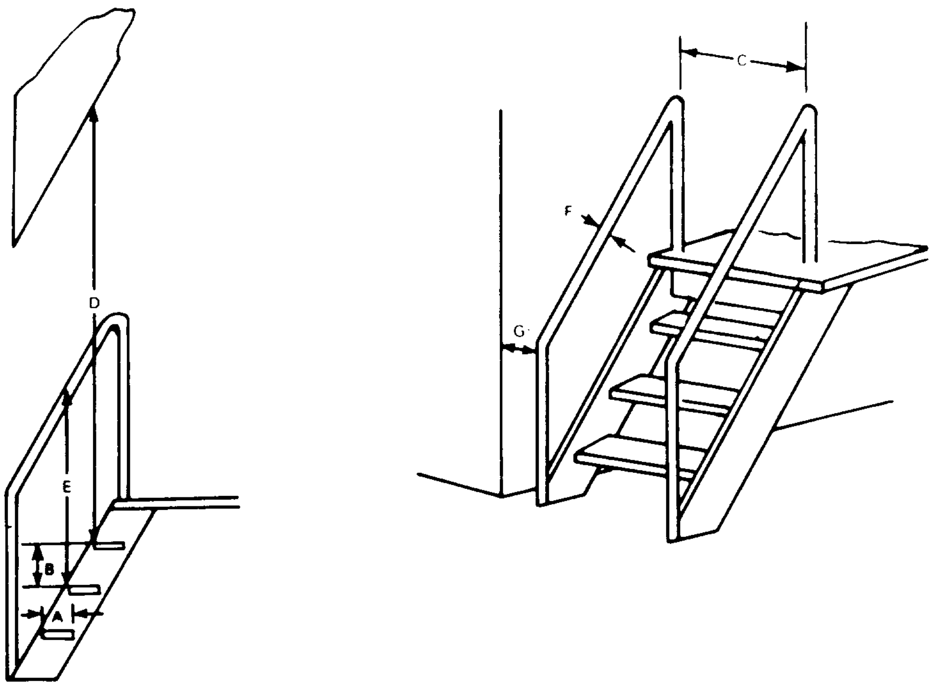
Note "A". Dependent on angle of horizontal.

Non Skid Finish: Welded bar grating treads without nosings are acceptable providing the leading edge can be readily identified by personnel descending the stairway and provided the tread is serrated or of definite non-slip design.

* Stairs with treads of less than 9-inch width should have open risers.

**Pipe Railings

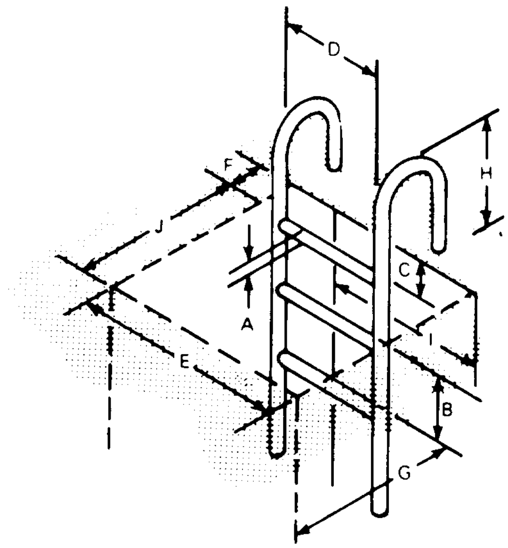
Fig 15—Stair Dimensions



DIMENSION		MINIMUM	MAXIMUM	RECOMMENDED
A	Tread depth range:			
	For 50° rise	6.00"	10.00"	8.50"
	For 75° rise (open ladders only)	3.00"	5.50"	4.00"
B	Riser height (open risers if tread depth∠9.00")	7.00"	12.00"	9.00"
C	Width (handrail to handrail)	22.00"	24.00"	22.00"
D	Overhead clearance	84.00"	. . .	84.00"
E	Height of handrail (from leading edge of tread)	34.00"	37.00"	35.00"
F	Handrail diameter*	1.50"	3.00"	1.50"
G	Rail clearance from wall	1.50'	. . .	3.00"

*Pipe Railings

Fig 16—Stair-Ladder Dimensions



	DIMENSION	MINIMUM	MAXIMUM	RECOMMENDED
A	Rung thickness:			
	Protected metal	0.75"	1.50"	1.40"
	Corrosive metal	1.00"	1.50"	1.40"
B	Rung spacing *	9.00"	12.00"	12.00"
C	Height, rung to landing	6.00"	Rung Spacing	Rung Spacing
D	Width between stringers	16.00"	. . .	18.00"-21.00"
E	Climbing clearance width	30.00"	. .	40.00"
	Clearance depth:			
	F In back of ladder	7.00"	. . .	8.00"
	G On climbing side (range) Centerline of rung to nearest permanent object on the climbing side of the ladder. **	36.00" for 75° to 30.00" for 90°	. . .	
H	Height of stringer above landing	33.00"	. . .	36.00"
I	Distance from centerline to side wall	15.00"	. . .	20.00"
J	Opening**	24.00"	. . .	30.00"

* To be uniform throughout the length of the ladder.

** There shall be no protruding potential hazards within 24 inches of the centerline of the rungs or cleats: any such hazards within 30 inches of the centerline of the rungs or cleats shall be fitted with deflector plates placed at an angle of 60 degrees from the horizontal.

Fig 17—Fixed-Ladder Dimensions

5.15 ***Access Between Aisles.*** There are three types of access for moving between alleys and the CEF exit:

(a) A horizontal passageway through the cable-framing structure, connecting the various aisles with the exit. In a design of this type, try to avoid situations that will require you to depress or raise cables to accommodate the passageway.

(b) An elevated catwalk connecting the aisles with one another and the exit. (See Fig 18.)

5.16 The safest design for access between aisles is one which minimizes changes in elevation (horizontal accessway). Certain conditions may limit their use, however. Space between aisles should conform to the following:

aisle width - at least 36 inches; this minimum condition exceeds the safety requirement of 28 inches.

ceiling height - at least 7 feet 6 inches, with projections from ceiling no less than 6 feet 8 inches from the floor.

stair angles of ascent - given in Fig 15 and 16. (Ladder specifications are shown in Fig 17.)

LIGHTING

5.17 ***Normal Lighting.*** The lighting system of the CEF should enable employees to safely carry out their routine observations and to have easy access and egress to and from the CEF. The average horizontal illuminance level shall be 5 foot-candles, measured 5 feet above the floor. Since this level of illumination must be maintained throughout the life of the CEF, the lighting layout should account for possible future cable and structure framing obstructions. It is recommended that the normal lighting be installed below, and in conjunction with the installation of the CEF cable racking structure. (See Fig 19 for typical above-surface and subsurface CEF lighting fixture layouts.) Care should be exercised that lighting fixtures are placed where they will not be blocked in the present or future by cable or equipment; access must be maintained to permit normal lighting maintenance.

5.18 Lighting fixtures should be selected which will not only provide reliable and continuous service life, but are simple in design and free from hazardous corners, edges, etc.

5.19 ***Emergency Lighting.*** Emergency lighting for the CEF shall be provided to ensure safe egress of employees. The standards for emergency lighting shall be:

(a) Emergency lighting shall be automatically energized when normal light fails, without appreciable interruption in lighting.

(b) The exit illuminance level shall be not less than 1.0 foot-candle at the floor level.

(c) Failure of any single lighting unit shall not leave the CEF in total darkness.

(d) The exit way shall be clearly illuminated and marked in such a manner that no confusion will exist as to the exit's location.

ELECTRICAL POWER

5.20 Electrical outlets should be provided in the CEF to meet the CSPEC requirements.

VENTILATION

5.21 ***Ventilation.*** A mechanical ventilation system is recommended to provide a continuous one-half an air-change per hour to the enclosed CEF. In order to prevent condensation on the walls or cables in the CEF, the air supply should be obtained from an air conditioned area inside the building and supplied to the enclosed CEF near the ceiling in the area of the cable duct entrance. This air flow should be directed downward into the CEF. A fire-damper shall be provided in the supply duct at the penetration into the CEF. The existing vent pipes may be used to exhaust the supply air. No less than two exhaust vent pipes shall be used, one located at each end of the CEF space. The exhaust vents should be located remote from windows and other building air intakes. To keep foreign objects out of the CEF, the exhaust openings should be equipped with louvers and 1/2-inch wire mesh screen. No fans should be installed inside the CEF area.

5.22 For most CEFs, one-half air change per hour will require only 100 to 200 cubic feet per minute (CFM) of continuous air supply. This small amount of air supplied from the telephone equipment room will have an insignificant effect on the primary heating, ventilating, and air conditioning system air balance and building infiltration, but will be adequate to prevent the accumulation of a combustible gas mixture unless there is a major gas line rupture and leak directly into the CEF. Testing and purging pro-

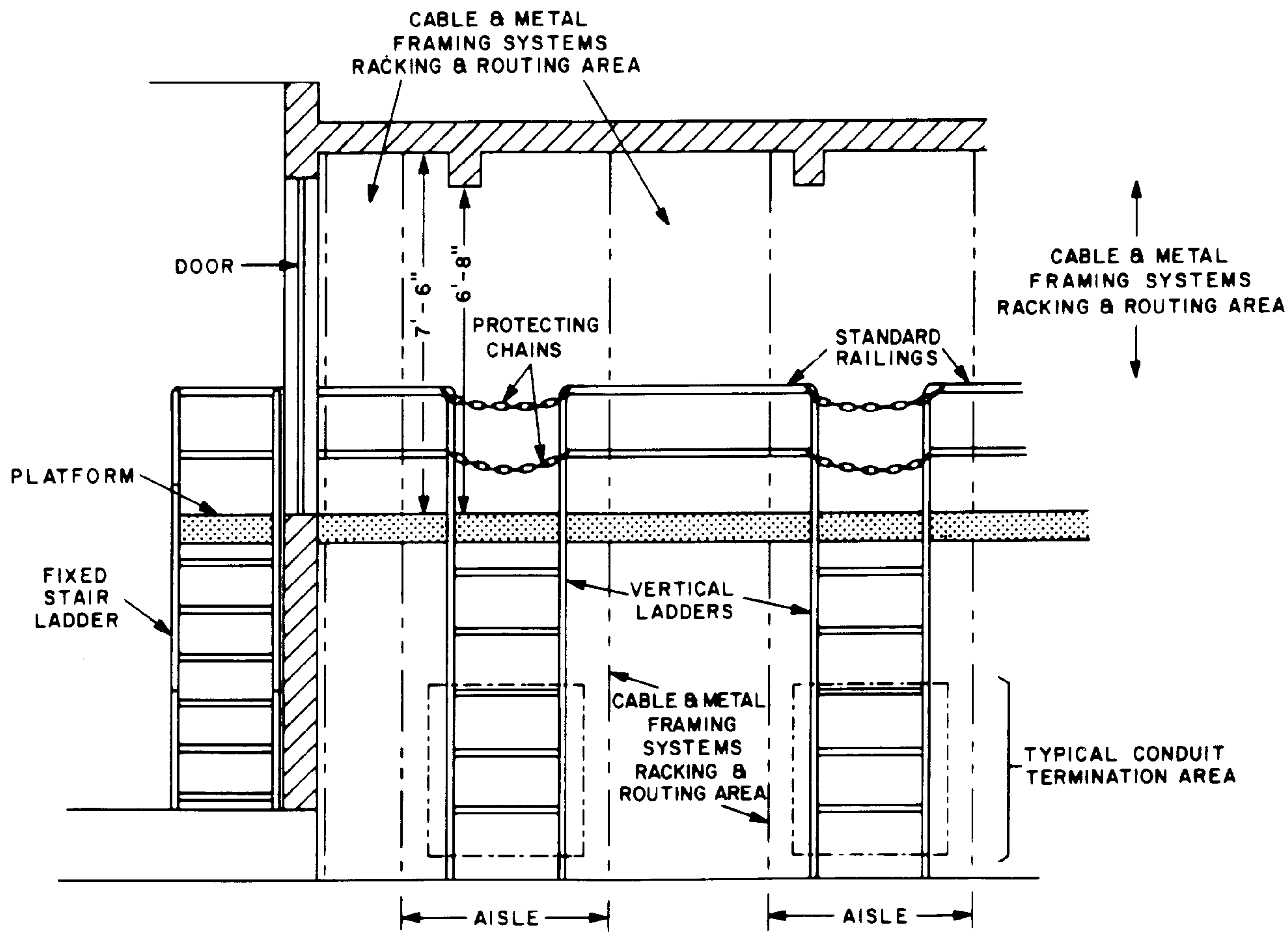


Fig 18—Elevated Catwalk

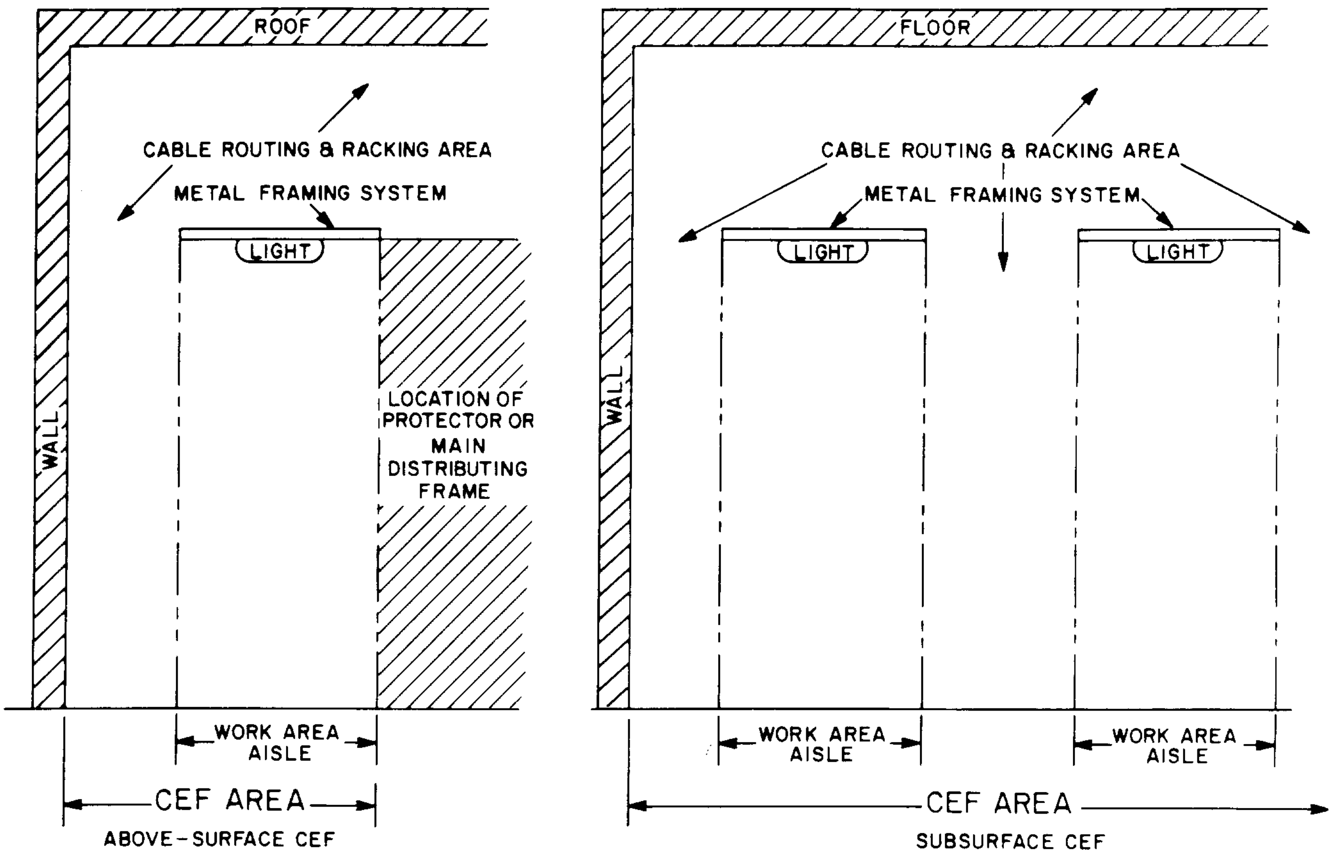


Fig 19—Typical CEF Lighting Layouts

cedures such as those described in BSP 620-140-501 should be followed. ***It is recommended that mechanical ventilation be used in all new enclosed Cable Entrance Facilities, and Cable Entrance Facilities which are being rehabilitated.***

5.23 *Flooding.* Subsurface CEFs located in geographic areas where rivers may flood, or where there are high groundwater tables, may require curbs, drains, pumps and plumbing to ensure that water can be removed when flooding occurs. If part or all of the CEF may be below the ground water table, the design should include membrane coverings on the walls, and where applicable, water-tight connections and rubber or copper water stops in construction joints. Also, some type of warning device (high-water alarm) should be installed in the CEF to warn the appropriate building personnel that a potential flooding condition exists. In locations where high-water conditions are not a major threat, documented procedures should be posted in the CEF on how water would be discharged should it suddenly appear in the CEF. Where automatic pumps are installed, testing and routine maintenance must be performed on the units. An inspection log of these maintenance activities should be maintained within the CEF.

5.24 In locations where there is a high risk of flooding, and a subsurface CEF is required, cable closures should be positioned above the probable high water level, if at all practical.

GAS PROTECTION

5.25 *General.* It is important to prevent gas from seeping into the CEF. Four types of harmful effects result from gas seepage: explosive, toxic, irritating, and suffocating. Table B lists the most common hazardous gases encountered in the underground plant and their effects. Although gases may enter the basement area through cracks, holes, or the natural porosity of the building materials, ***gas seepage is more likely to occur through and around subsurface pipe and conduit penetrations, if these areas are not adequately sealed.*** To prevent hazardous gases from entering the CEF through telephone conduits, all underground telephone conduits should be routed through gas venting chambers before they are terminated in the CEF walls or floors. The gas venting chamber should be used in conjunction with the Bell System's approved conduit plugging practices. It is not an alternative to those procedures.

5.26 *Gas Venting Chamber.* The required gas venting chamber is similar in design for both the above-surface and subsurface CEF. The subsurface CEF usually has conduits terminated at the end walls in one formation or in several clusters (splayed formation). (See Fig 20.) For this type of entry configuration, the chamber should be an integral part of the wall of the CO building. In the above-surface CEF (Fig 21), conduits may either terminate in a manner similar to that of subsurface CEF conduits, or in the CEF floor along the building perimeter; the gas venting chamber can either be a free-standing structure or an integral part of the building wall.

5.27 *Chamber Design.* The gas venting chamber should conform to the following requirements. For splayed termination, see Fig 22; for cluster termination, see Fig 23.

- It must withstand the weight of subsoil and surface loads.
- Its walls, roof, and floor should be of reinforced concrete.
- It should be as small as possible although its size will depend on the number of terminations to be served.
- There should be no more than 12 inches of free space between the conduit formation and the walls, roof or floor.
- Adequate width should be provided for the termination of two 4-inch venting pipes and a 10-inch purge port.
- Individual conduits passing through the gas venting chamber should be perforated to allow both heavy and lighter-than-air gases to escape from the conduit into the chamber. (The vent holes should be staggered along top, bottom, and sides of the conduit.)
- There should be as little space as possible between conduit lengths inside the chamber to avoid conduit misalignment.
- The vent area in each conduit shall be equal to at least one-half the cross-sectional area of the conduit (eg, a 4-inch conduit will require at least eight 1-inch-diameter holes per conduit).

TABLE B

HAZARDOUS GASES AND THEIR EFFECTS

HOUSEHOLD GASES		
TYPE	DANGEROUS CONSTITUENT	EFFECT
Manufactured Gas	Carbon Monoxide, Hydrogen	Toxic and Explosive
Mixture of Manufactured and Natural Gas	Carbon Monoxide, Hydrogen, and Methane	Toxic and Explosive
Natural and Petroleum Gas	Methane, Ethane, Ethylene, Propane, Butane, and Hexane	Suffocating and Explosive
Natural Gas	Methane	Suffocating and Explosive

SOIL GASES		
TYPE	DANGEROUS CONSTITUENT	EFFECT
Hydrogen Sulphide	Hydrogen Sulphide	Toxic and Explosive
Carbon Dioxide	Carbon Dioxide	Suffocating
Marsh Gas	Methane	Suffocating and Explosive

COMMERCIAL GASES		
TYPE	DANGEROUS CONSTITUENT	EFFECT
Sulphur Dioxide	Sulphur Dioxide	Irritating
Ammonia	Ammonia	Irritating
Butadiene	Butadiene	Explosive
Hydrogen Sulphide	Hydrogen Sulphide	Toxic and Explosive

LIQUID FUEL GASES		
TYPE	DANGEROUS CONSTITUENT	EFFECT
Gasoline	Fumes (Hydrocarbons)	Toxic and Explosive
Benzol	Fumes (Hydrocarbons)	Toxic and Explosive
Fuel Oils	Fumes (Hydrocarbons)	Irritating and Explosive

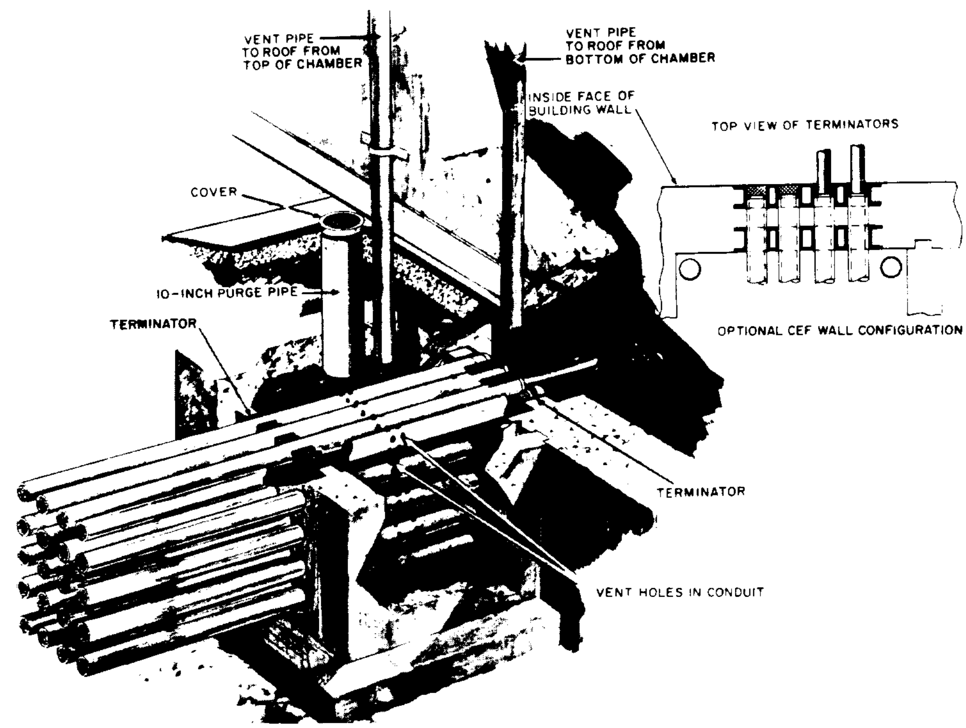


Fig 20—Gas-Venting Chamber of Subsurface CEF

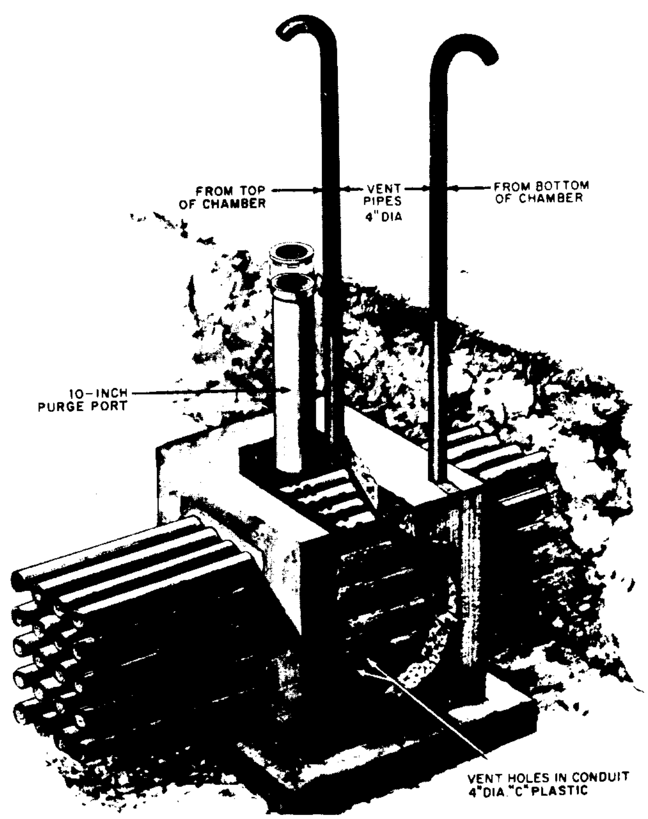


Fig 21—Gas-Venting Chamber of Above-Surface CEF

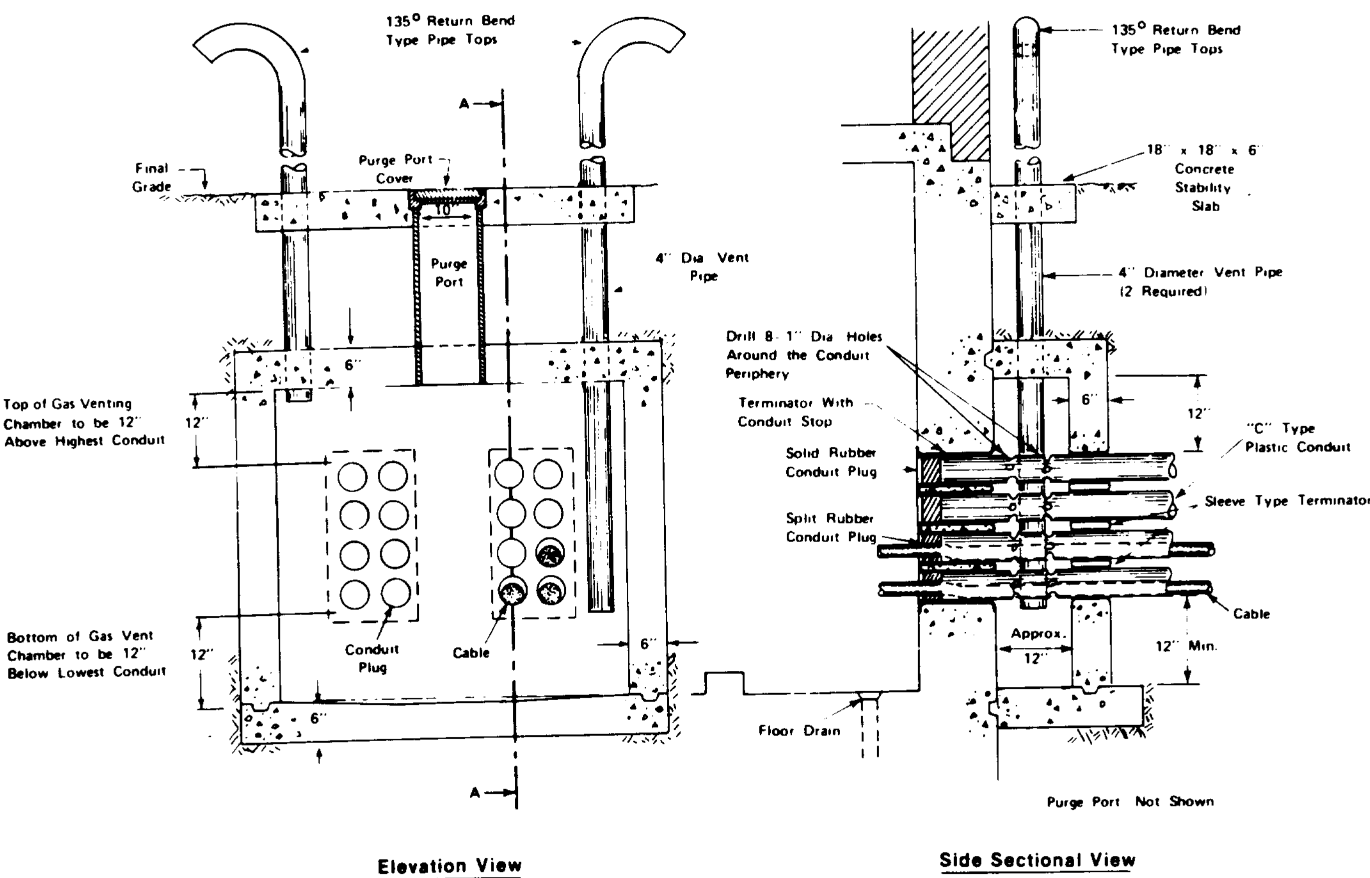


Fig 22—Gas-Venting Chamber of Splayed Termination Subsurface CEF

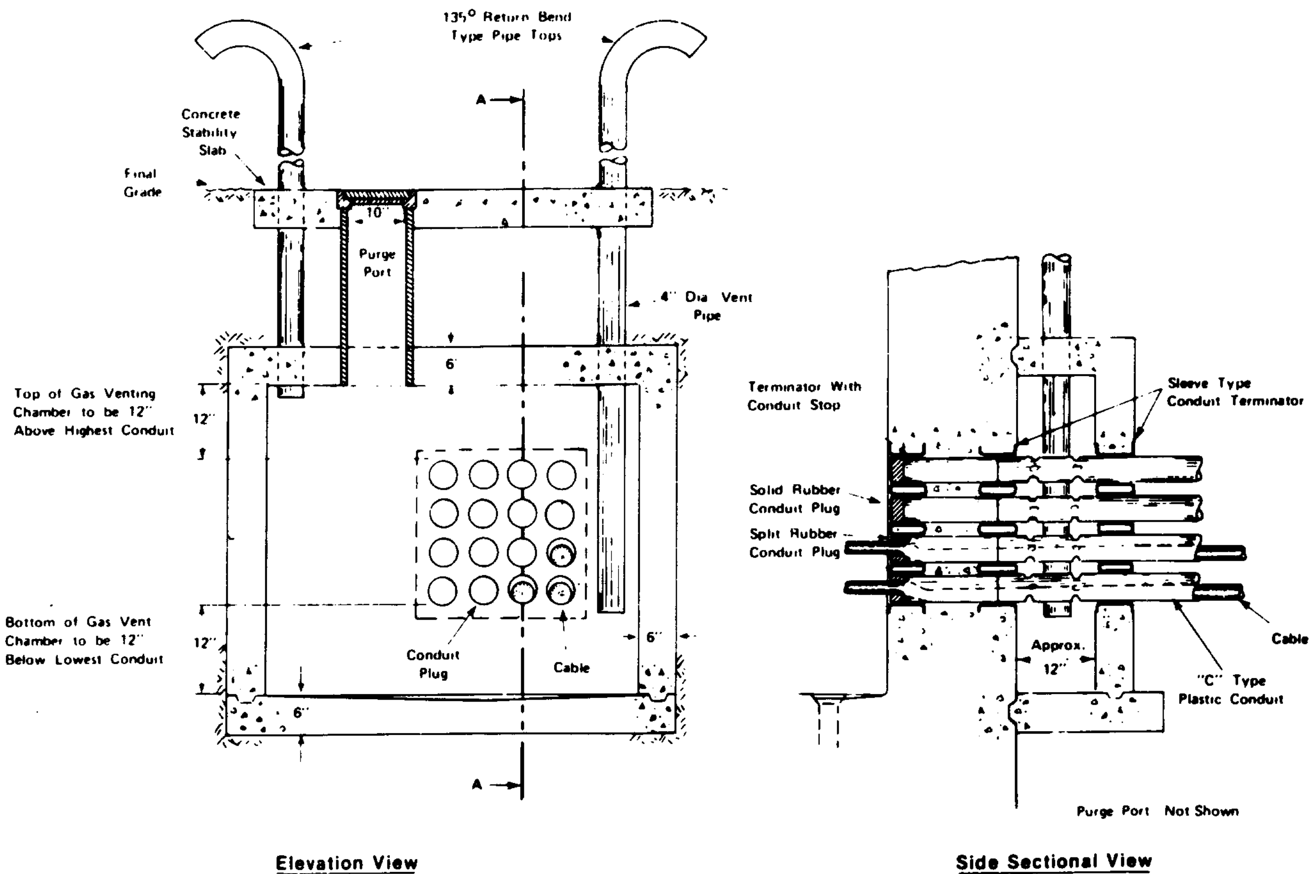


Fig 23—Gas-Venting Chamber of Cluster-Termination Subsurface CEF

- A minimum of two 4-inch venting pipes shall be installed in each venting chamber to achieve maximum natural ventilation for heavy and lighter-than-air gases.

One vent pipe should terminate at the top of the chamber and the other approximately 12 inches above the chamber floor. These two vent pipes extend above the ground line and along the outside central office wall to an elevation above the building roof. If the chamber is designed as a free-standing structure, or if the pipes do not extend to the roof line in a "building-type" chamber, vent pipe height should be extended above any expected snow pile-up or surface flooding. The tops of the vent pipes must be positioned to prevent reentry of gases through windows or other ventilation openings. They may terminate at the same or alternate elevations above the ground. The tops of the free-standing vent pipes should be fitted with 135-degree return bend sections (positioned 180 degrees to one another) or some other approved device that is adequate for gas purging.

5.28 ***Plastic Duct Terminators.*** The use of plastic duct terminators for conduit entrances in the CEF offers several advantages:

(a) They can be cast into the CEF wall at the time of construction, with conduit added later.

(b) They can be interlocked into panels or purchased in special configurations to provide almost any desired conduit entrance formation.

(c) They can be used to simplify the construction of gas venting chambers.

(d) They can be obtained with an integral member which seals the unused terminator opening against entrance of gas, water or debris.

(e) They are light, easy to use, and, when constructed as a grid, provide for an evenly spaced conduit formation.

(f) Their use can improve conduit plugging procedures, especially with large-diameter cable.

5.29 ***Water Removal from the Chamber.*** Provision should be made in all chambers for draining entrapped water before removing the conduit plugs in the CEF. If possible, the bottom of the chamber should be higher than the adjacent connecting manholes. Draining the central office manhole or adjacent connecting manholes, in preparation for the placement of cable, would thus normally drain the conduits as well. In areas where there is occasional flooding, or where a high water table exists, and the above method does not seem appropriate, then the 10-inch purge port (Fig 22 and 23) between the roof of the chamber and the ground surface should be used for discharging the trapped water with the aid of portable pumps.

5.30 ***Securing Purge Port Cover.*** The purge port cover should be locked to prevent unauthorized access to the gas venting chamber.

FIRE PROTECTION

5.31 ***General.*** The CEF is unlike most other building spaces in the central office. As a rule it is infrequently occupied, often located in a remote area not readily visible from other equipment spaces and, when located below the equipment space (eg, in the basement) it is often enclosed by walls and secured with a locked door.

5.32 The individual who plans CEF fire protection must consider the CEF configuration. The ***subsurface*** CEF is most often located directly under one or several terminating frames. The ***above-surface*** CEF is often adjacent to the terminating frame but may be located on the first or any other level of the central office building. Both configurations are further characterized by whether they are enclosed or unenclosed spaces. An enclosed CEF is surrounded on all sides by walls, partitions or other isolating structural elements to separate this space from adjacent building spaces. The unenclosed CEF is open to adjacent work or equipment spaces, and most often will share the lighting and environments of these adjacent spaces.

5.33 ***Fire Safety Application Criteria*** for telephone equipment buildings are contained in BSP 760-600-210.

COMPARTMENTATION

5.34 ***General.*** The central office is normally compartmented to minimize the spread of fire.

5.35 ***Enclosed CEF Areas.*** Cable Entrance Facilities in new buildings of more than 10,000 square feet ***should be enclosed by a minimum one-hour fire-rated wall or partition.*** Cables which pass through the floors and ceilings of the enclosed CEF shall be fire-stopped to achieve a two-hour resistance, or shall provide a resistance equal to that of the penetrated assembly. For arrangements in typical enclosed subsurface CEFs, see Fig 24a; for above-surface CEFs, see Fig 24b.

5.36 Cable Entrance Facilities in buildings of over 25,000 square feet, or with more than three levels, should be enclosed in fire-rated compartments. Provision should be made for future compartmentation in buildings planned for expansion beyond 25,000 square feet.

5.37 ***Unenclosed CEF Areas.*** Cable Entrance Facilities of less than 10,000 square feet need not be enclosed by walls for fire protection.

5.38 However, cables routed to other building levels shall be fire stopped at the cable opening and shall achieve 2 hour fire resistance. Compartmentation requirements are contained in BSP 760-630-400.

FIRESTOPPING

5.39 ***General.*** Considering the methods of routing connector stub cables to the frame and the requirements of routing large-size feeder cables between various levels in the CO, the fire stop must satisfy the following criteria:

(a) It must be flexible enough to allow the removal and placement of cables on demand.

(b) It must be able to accommodate various numbers and sizes of cables, ranging from the individual connector stub cable to the large number of inter building riser cables.

(c) It should offer fire protection when the duct or riser is not occupied with cable.

(d) It should be easily installed or removed, and should be of very high physical integrity, so that it will perform reliably when required.

5.40 Detailed information on firestopping requirements are contained in BSPs 760-600-210, 760-630-410, and 760-630-420.

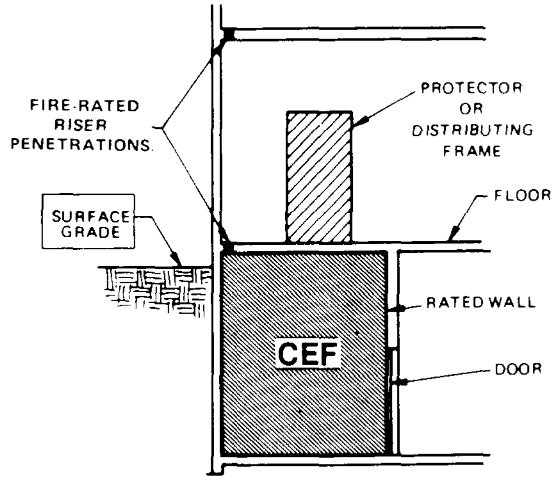


Fig 24a—Fire Protection of Enclosed Subsurface CEF with Rated Walls

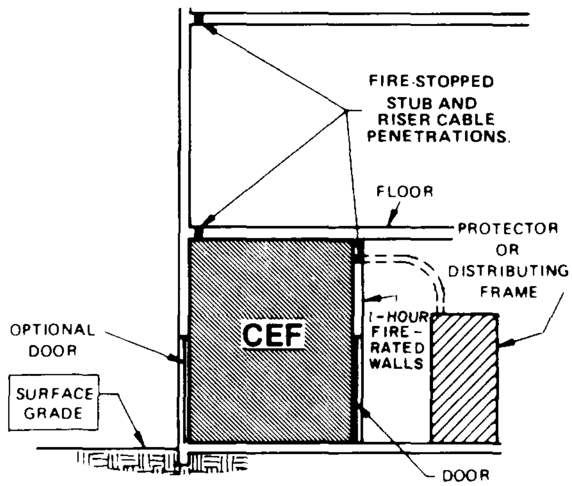


Fig 24b—Fire Protection of Enclosed Above-Surface CEF

DETECTION-SUPPRESSION

5.41 ***Detection.*** Subsurface and enclosed above-surface cable entrance facilities shall be protected by an Early Warning Fire Detection System (EWFDS). EWFDS detects a fire in its earliest stage of development and activates a local alarm.

5.42 Detectors should be spaced so that no detector will monitor an area in excess of 400 square feet. Detection systems should be installed in accordance with BSP 760-650-100.

5.43 ***Suppression.*** Portable hand-held fire extinguishers shall be used within the CEF as the initial suppression system in case of a CEF fire.

Class A-rated water extinguishers and Class BC-rated extinguishers shall be provided at each extinguisher station. Extinguisher stations shall be located adjacent to all entry locations, primary and secondary exits, and at such intervals as to limit the distance from any point within the CEF to the nearest extinguisher to 75 feet . BSP 760-640-200 addresses the distribution of portable fire extinguishers.

5.44 Spacing and travel distance requirements can be met by securing extinguishers on wall-mounted brackets, on brackets extended from the cable framing structure, or on floor-mounted support frames; their location should not restrict or block future cable placing or splicing operations. Extinguishers may extend into work alley areas as long as they do not block or restrict safe passage of personnel nor restrict the movement of ladders, platforms or other equipment in the CEF work space. Extinguishers within the work alley should not be subject to accidental discharge during cable placement or maintenance activity near the station. Extinguisher stations should be easily reached, and if direct visibility is obscured, their locations must be clearly identified by legible signs, red bands, arrows, etc.

6. SECURITY

6.01 ***Internal Security.*** Security measures should be instituted for CEFs that are located beyond oversight by central office supervision (eg, in the subsurface or enclosed above-surface CEF). Security measures should achieve the following:

- prevent unauthorized entry
- ensure prompt access to the CEF in an emergency.

Entry into the CEF can be controlled by log-in and log-out procedures and a keylock system with an emergency override feature. A combination lock system is not recommended, because it can be easily broken. All doors and hatches must have latches or release mechanisms that make it easy for people to pass through during an emergency. Emergency exits should also have alarms to indicate that entry or exit has occurred. In addition, an internal communications circuit should be provided between the main equipment area or any other normally occupied CO equipment-space to permit CEF occupants to call for assistance in case of emergency. In central offices that are not always occupied, a telephone circuit should be provided to permit outside calls for assistance in case of an emergency.

7. CABLE ENTRANCE FACILITY CHECKLIST

7.01 ***General:***

(a) Employ an above-surface CEF system at small (Community Dial Offices) and medium single-entity electronic switching buildings.

(b) Utilize subsurface and duplex CEF systems at multistory and multientity buildings.

(c) Provide a CEF length consistent with the ultimate length of the MDF.

(d) Provide space at the conduit entrance termination for feeder cable routing functions.

(e) Consider ultimate expansion plans for the building during the selection and design of the CEF.

(f) Provide fire-rated plugs for unused cable openings.

(g) Provide means for continuous illumination during occupancy with automatically energized emergency lighting.

(h) Provide a mechanical venting system to inhibit moisture condensation on the CEF surfaces and hardware and to provide a complete air change in the CEF at least every 2 hours.

(i) Provide gas venting chambers.

(j) Provide pulling-in irons and cable-feed holes based on the cable installation methods employed.

(k) Select the number of aisles based on the CEF design selected, coupled with the frame requirements.

(l) Provide floor drains and sump pumps when required.

(m) Provide riser space to satisfy future riser cable requirements.

8. BUILDING CONSTRUCTION DOCUMENTS

8.01 The Building Project Manager's objective is to provide construction documents (drawings and specifications) for building the Cable Entrance Facility (integral to the building). The documents should include architectural, engineering, site and other information required for completion of the facility. Figures 25, 26, 27 and 28 illustrate typical construction documents for a CEF.

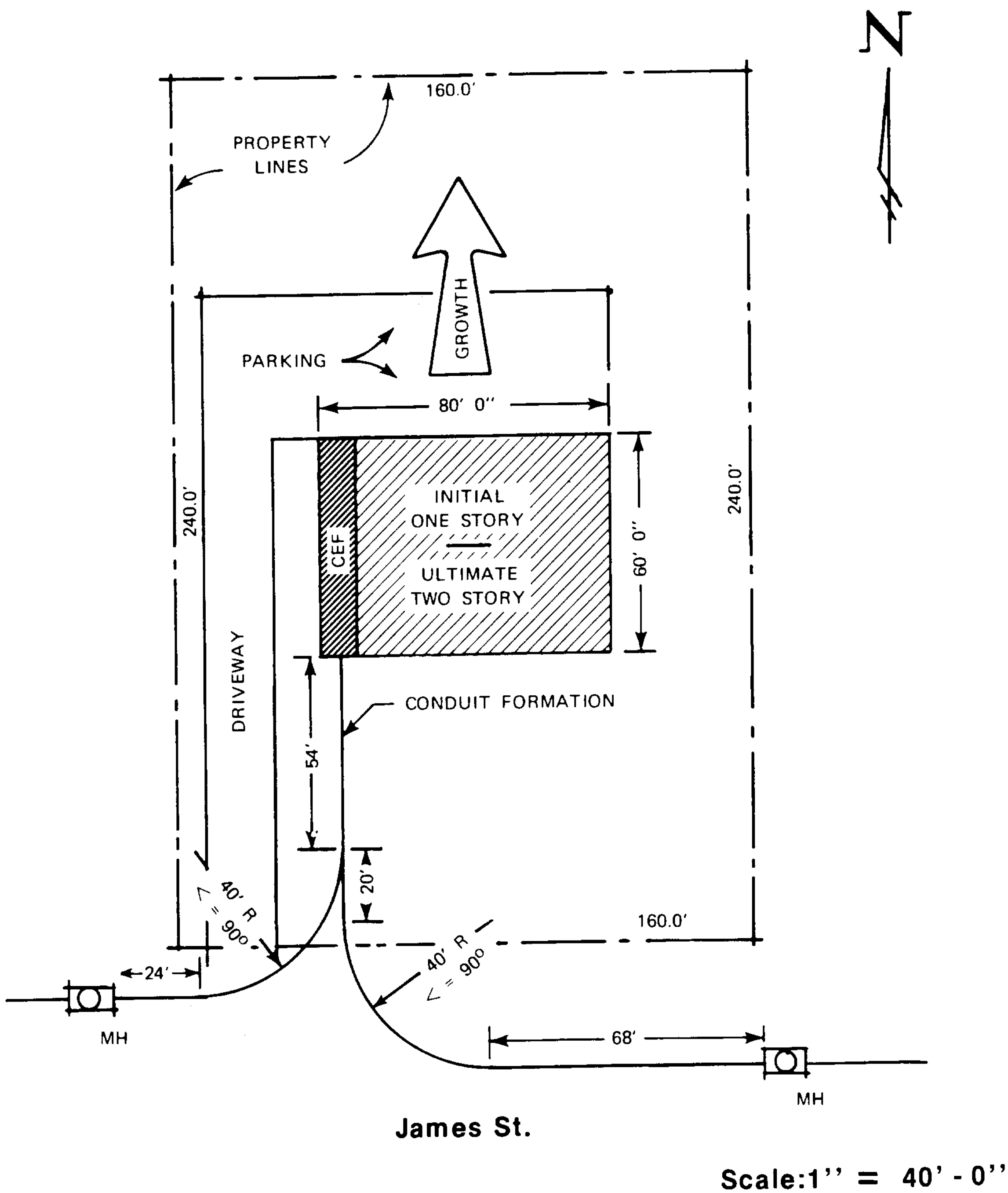


Fig 25—Plot Plan

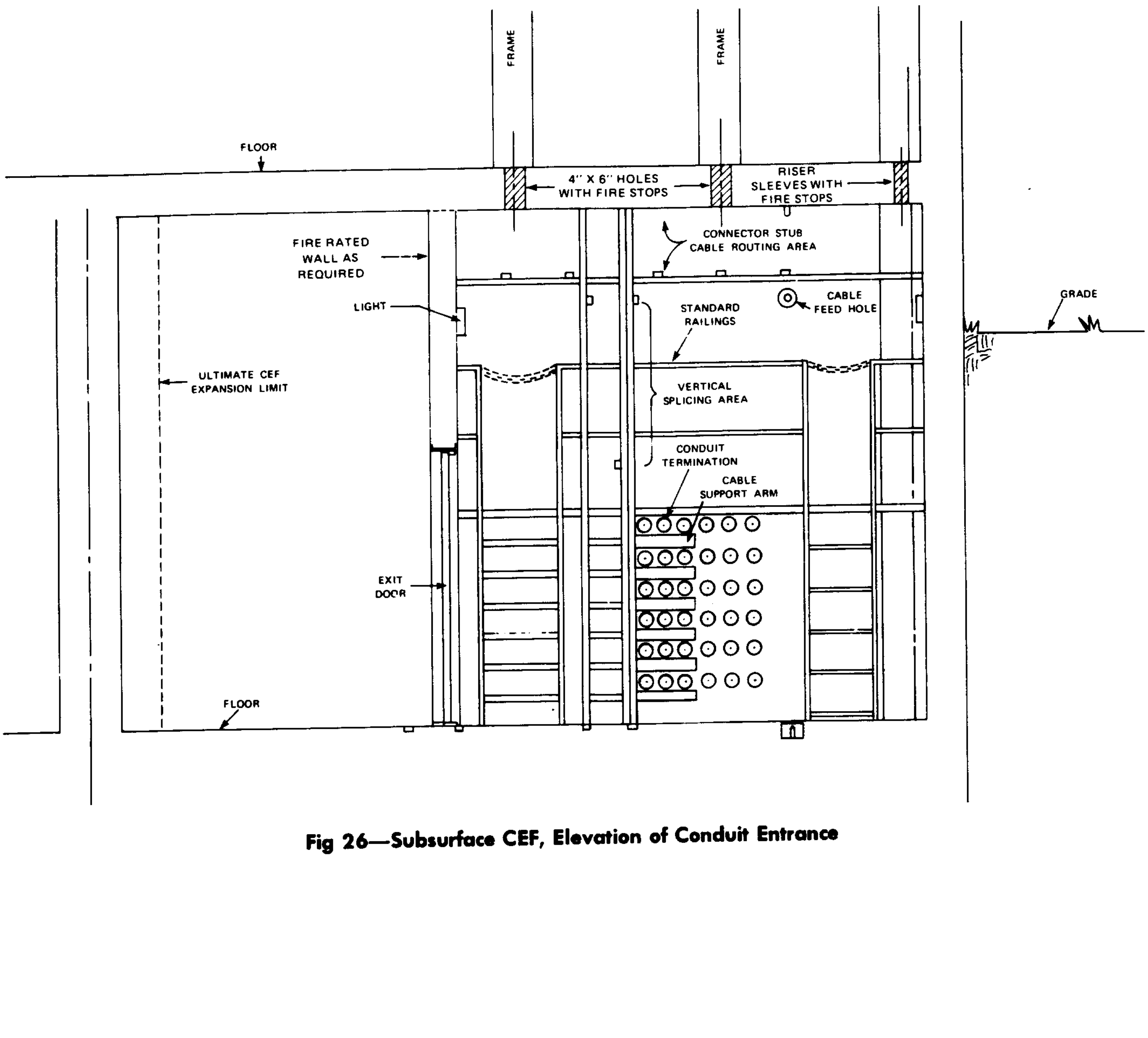


Fig 26—Subsurface CEF, Elevation of Conduit Entrance

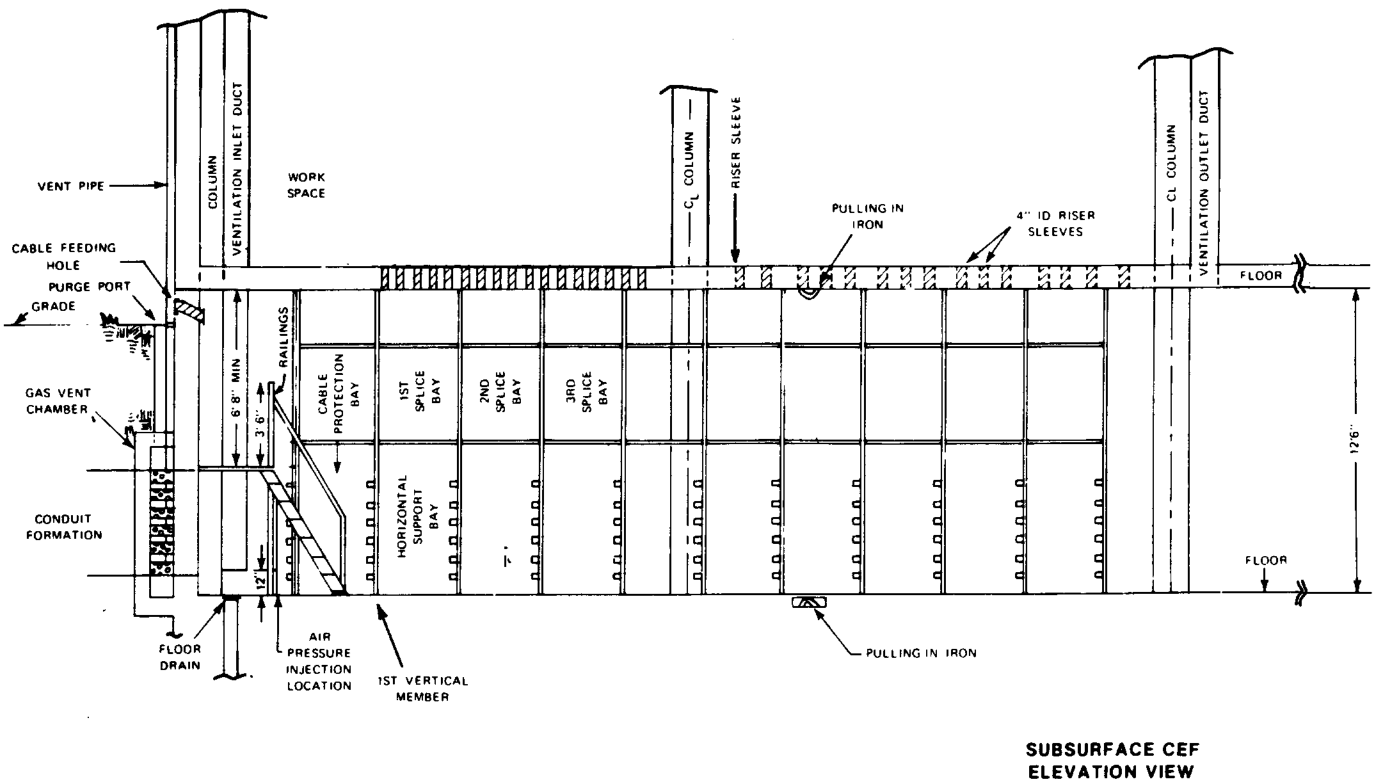


Fig 27—CEF, Partial Building Section Elevation of Cable Framing Structure

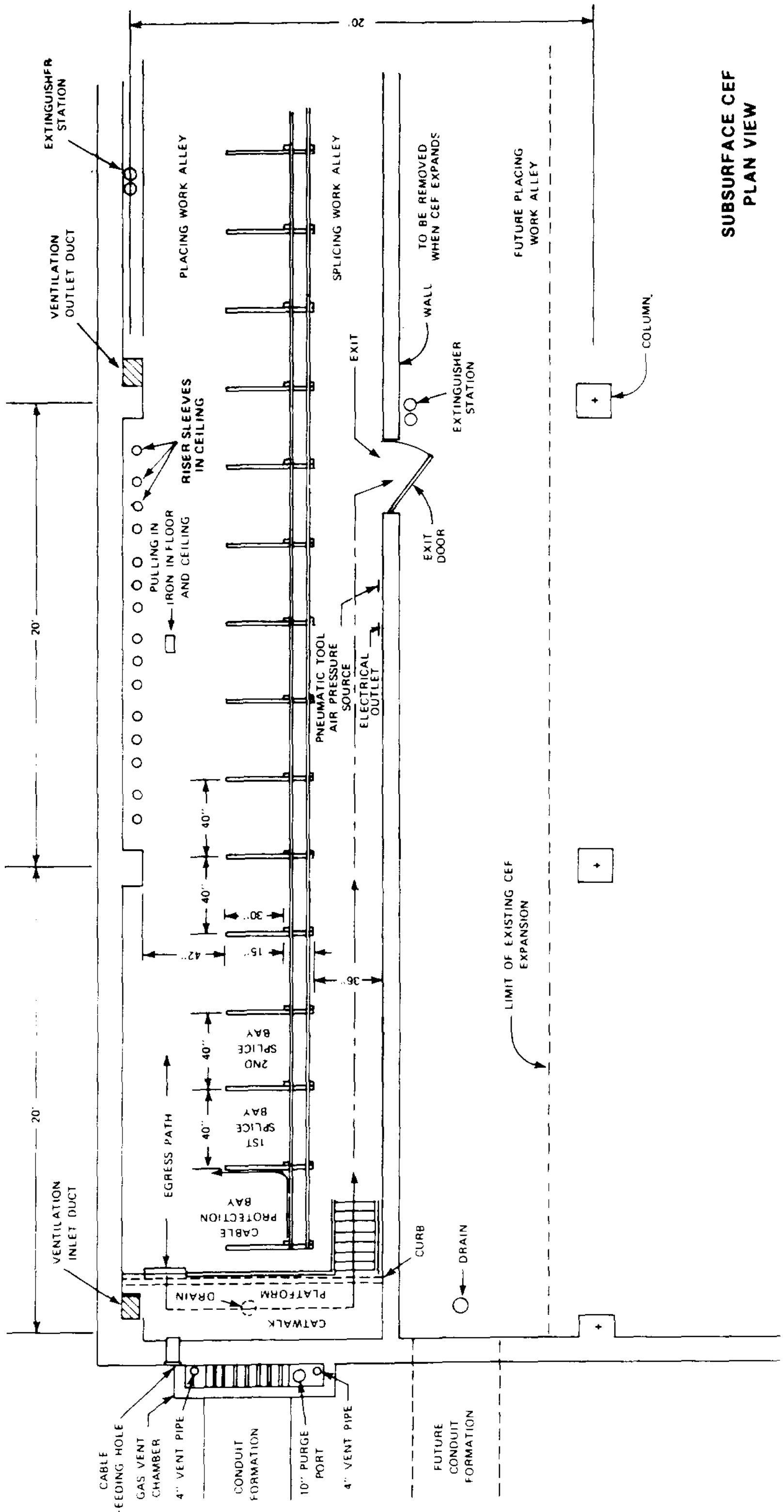


Fig 28—CEF, Partial Plan

9. REFERENCES—BSPs

1. Section 622-700-100—Central Office Cable Vaults List of Unistrut Material
2. Section 622-700-200—Central Office Cable Vaults Construction of Unistrut Frame
3. Section 760-200-031—CEF Conduit Entrances, Holes and Risers
4. Section 760-200-032—Cable Opening Design Standards
5. Section 760-600-210—Firesafety Application Criteria for Telephone Equipment Buildings
6. Section 760-630-400—Firesafety-Compartmentation (Issue 2, 11/80)
7. Section 760-630-410—Firesafety, General Fire Stopping Considerations For Floor And Wall Penetrations And Protection of Cable Runs
8. Section 760-630-420—Firesafety Modular Cast-In-Place Firestop For Distributing Frame Openings
9. Section 760-640-200—Distribution of Portable Fire Extinguishers
10. Section 760-650-100—Firesafety, Fire Detection Systems
11. Section 781-800-005—Cable Entrance Facility Planning and design (CSPEC)
12. Section 800-610-164—Network Equipment Building System (NEBS) General Equipment Requirements
13. Section 800-614-153—Sheathing for Cable Openings, Installation, General Equipment Requirements
14. Section 919-240-610—Cable Entrance Facility (Distribution Service Engineering Guidelines for Designing A New Facility or Enlarging An Existing Facility Distribution Service)