NEW EQUIPMENT—BUILDING SYSTEM (NEBS)
BUILDING ENGINEERING STANDARDS (BES)
BUILDING AND EQUIPMENT LAYOUT
GENERAL CONSIDERATIONS

1. GENERAL

1.01 This section introduces the Bell System Practices that provide standards and guidelines for building space planning and equipment system layouts for NEBS central offices and transmission stations. These practices apply to systems and equipment that meets the requirements of Bell System Practice 800-610-164, "New Equipment—Building System (NEBS), General Equipment Requirements," or Technical Reference PUB 51001 for General Trade equipment. They apply in the use of NEBS equipment in new buildings, building additions, or in existing building space.

1.02 Whenever this section is reissued, the reasons for reissue will be listed in this paragraph.

1.03 As they become available, these practices will supersede existing practices or sections of Specification X-74300, "NEBS Building Engineering Standards (BES), Part I, Building and Equipment Layout" as indicated below:

SECTION	TITLE
760-100-001	Building Planning— General Considerations
760-100-010	Building and Equipment Space Planning—The Process (BES Section 1)
760-100-015	NEBS Standards—Building and Equipment Layout—Introduction (BES Preface and Introduction)
760-100-020	Selection of Building Sites for COs
760-100-021	Land Survey Information
760-100-030	NEBS in New Buildings—(BES Section 4.1)
760-100-032	NEBS in Existing Buildings (BES Section 4.2)
760-100-040	Telephone Office Planning and Engineering System (TOPES)
760-100-041	TOPES—Operating Guide
760-100-045	Office Planning Data— Floor Plan and Power Data Sheets
760-100-046	Floor Space Estimating for NEBS Offices
760-100-050	Planning No. 1 ESS
760-100-055	Planning No. 2 ESS—(BES Section 2.2)
760-100-060	Planning No. 3 ESS
760-100-065	Planning No. 4 ESS—(BES Section 2.4)
760-100-070	Planning Long Haul Radio Relay Stations (BES Section 3.1)
760-100-071	Planning Small Radio Relay Stations—(BES Section 3.2)
760-100-080	Planning Analog Carrier Terminal Offices—(BES Section 3.7)
760-100-085	Planning Digital Carrier Terminal Offices—(BES Section 3.6)

SECTION	TITLE
760-100-090	Planning for Distribution Frames
760-100-095	Planning for Via Cabling
760-120-160	Project Planning Service Operation Centers
760-150-150	Building Planning for Electronic Data Processing Systems
760-150-155	Planning for Operations Support Systems Computers
760-160-100	Fire Protection Planning (BES Section 8.1)

1.04 The availability of individual sections may be determined by reference to the current issue of the Numerical Index, Section 760-000-000.

2. HOW NEW STANDARDS EVOLVED

2.01 The impact on building design resulting from basic advances in switching, transmission, and power equipment will be felt increasingly as planning proceeds for new electronic Central Offices. The design standards for buildings were set originally to accommodate electromechanical switching equipment. With the advent of miniaturized equipment through the use of solid-state devices, new values for equipment size, weight, temperature, and cable density have appeared. The Bell Laboratories Office Planning Department made a preliminary study of the spatial requirements of the different types of equipment and buildings with an aim toward more effective and economical design. The group concluded that substantial benefits could be achieved by setting up new, more unified standards of design for communications equipment and the buildings that house electronic switching systems.

2.02 As a result of the preliminary study, a Task Force was formed by Bell Laboratories to review existing Central Office equipment and building standards in terms of existing and anticipated service and equipment requirements and to recommend appropriate design changes. The Task Force was composed of representatives from the areas of exchange and toll transmission, electromechanical and electronic switching, power, building development, and standards engineering.

2.03 In the course of its work, the Task Force reviewed Bell System equipment and building costs, its building construction program, and anticipated equipment-space requirements. Existing design trends in all aspects of Central Office equipment were determined and were basic elements in the study. The following equipment-building interrelationships were examined:

EQUIPMENT VARIABLES	BUILDING VARIABLES
Height, width, depth, and weight	Floor live load and ceiling height
Room layout	Equipment space needs
Cabling	Racks, slots, and vaults
Heat dissipation	Heating, ventilating, and cooling
Operation and maintenance	Aisles and service areas

3. NEW STANDARDS

3.01 As a result of these optimization studies, new methods were proposed to effectively integrate equipment and building design for electronic local and toll offices using electronic switching equipment. New Equipment-Building Standards have been approved for adoption throughout the Bell System. The plan is based on the following building design characteristics for 7-foot equipment systems.

10 feet	Clear ceiling height
12-1/2 feet	Top of floor slab to bottom of lowest structural member
150 psf	Equipment systems floor live load (including transient load)
20 × 20 feet	Building bay module size

3.02 New requirements for equipment have also been developed that are compatible with the plan and are given in "New Equipment-Building System (NEBS) - General Equipment Requirements," Section 800-610-164 and PUB 51001. These documents contain information on spatial and environmental requirements for equipment frames, distributing frames, power equipment, and cabling systems. The availability of equipment designed to the new specifications will facilitate the reuse of existing space, permit construction of more functional and economical buildings and will simplify the planning for installation of electronic central offices, toll centers, and stations.

4. STRUCTURAL COST FACTORS

4.01 The design of the building shell requires decisions on ceiling height, floor live load, and column spacing which, in turn, are influenced by equipment size, weight, and layout. It is clear that the floor-to-floor height of the building is controlled by the frame height of communication and power equipment, the space required for cabling, light fixtures, air distribution, and the floor design. Also, the design live load for the floor and column spacing is determined by equipment design and arrangement on the floor.

4.02 Based on studies made in 1970, for a ten-story building, variation in ceiling height influences total construction cost by about 4.5 percent per foot of height. Costs change by about 6 percent if the live load is increased from 150 to 300 pounds per square foot. For a two-story building, construction cost decreases about 3 percent as a result of going from 300- to 150-pound-per-square-foot floors.

4.03 The size and spacing of structural columns influence slab costs and equipment layout. To obtain maximum floor area utilization, column spacing perpendicular to the lineup must be a multiple of frame depth and aisle width. Building core costs are minimum with column spacing between 15 and 22 feet for typical floor loadings and types of construction. Area usage studies show efficient layouts with columns on 20-foot centers. This building bay module results in overall optimization, and permits adopting the American National Standards modular dimensioning for buildings.

5. EQUIPMENT COST FACTORS

5.01 If equipment weight, cooling, cabling, and maintenance were not controlling factors, installing equipment on high frames would permit reduced floor areas; this in turn would lower construction costs, because it is cheaper per cubic foot of building area to increase ceiling height rather than to expand horizontally. However, a study of equipment design trends reveals that the newer generations of telephone equipment have denser configurations, higher heat dissipation, and more critical cable connections per frame than the older equipment. Furthermore, the required clear ceiling height is basically the same for ESS areas, a large portion of the toll terminal equipment, all power equipment (including batteries), and nonequipment space. However, if high-frame equipment continues to be used in the carrier- and voice-frequency areas, and for distributing frames, this factor would determine ceiling heights for the building as a whole. With the use of lower frames for these types of equipment and present floor plans, the cost of additional floor areas required is offset by savings resulting from the use of lower ceilings over the entire building.

5.02 A 7-foot equipment frame height permits the adoption of compact floor plans for about two-thirds of the transmission equipment that are similar to the floor plans for the electronic switching equipment. The auxiliary framing and rolling ladders can be omitted. Utilization of reclaimed space made available through modernization programs will be facilitated, especially where clear ceiling heights are inadequate for the required cabling and air ducts over high-heat, high-bay equipment frames.

6. NEW EQUIPMENT-BUILDING SYSTEM (NEBS) COSTS

6.01 The equipment-building system, composed of 7-foot equipment frames, 3-foot overhead cable space, and a 12-foot 6-inch height from top of floor slab to bottom of lowest structural member will produce 8 percent savings in cost. The relative costs for various equipment-building systems are shown graphically in Fig. 1.

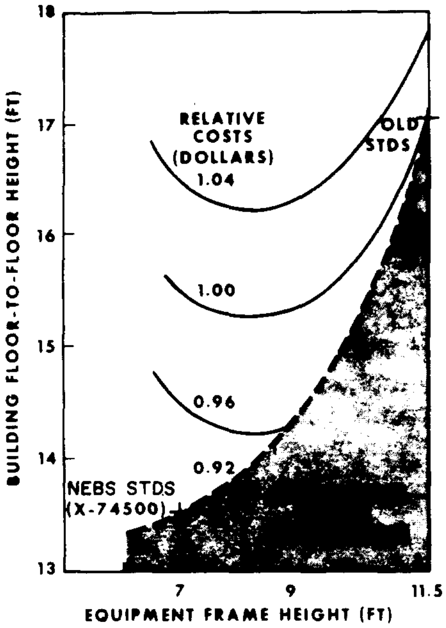


Fig. 1—Relative Costs for Equipment-Building Systems (1970)

6.02 The use of 7-foot frames, rather than 11-foot 6-inch frames, will alleviate equipment cooling problems. Reducing the equipment unit heat load for a given floor plan layout will permit more economical air distribution and reduce space required for ducts, thus avoiding the need for very wide aisles in areas of high-heat dissipation. Also, lower temperatures will occur in frames containing arrays of integrated circuit packs cooled by natural convection of air rising in the channels between boards.

6.03 It is expected that some additional reduction in maintenance costs and improvement in the quality of service will result from the general use of 7-foot frames. The elimination of rolling ladders will save several hundred dollars per building bay and will eliminate the hazards involved in working from ladders.

6.04 Use of 7-foot frames will decrease cabling and reduce congestion by permitting cable to be spread out in the overhead racks. Studies show that NEBS floor plans for transmission equipment shorten intrasystem cabling, and thereby reduce cabling costs substantially. This occurs by the use of more compact floor plans and additional cross-aisle racks, that are part of the Cable Pathway Plan.

7. SPACE CONCEPT AND FLOOR PLANS

A. In New Buildings

7.01 The spatial features for the recommended Central Office design are as follows. In the equipment area, a height of 7 feet above the floor is allocated for the frame, and 3 feet between the top of the frame and all structural elements and air ducts are allocated for racks, cabling, and bus bars. Typical equipment frame areas are shown in Fig. 2. In the main frame area, the height of frames plus associated cable and racks is limited to 9 feet to permit passage of via cable. Power equipment, including all overhead cable and supports, may extend to 10 feet. The 150-pound-per-square-foot floor live load is proportioned 140 pounds for equipment, racks, and cabling, and 10 pounds for transient loads, such as personnel and rolling equipment. If the Modular Cooling System (MCS), Section 760-550-300, is used, a portion of the 150-pound-per-square-foot limit will be required for the raised floor.

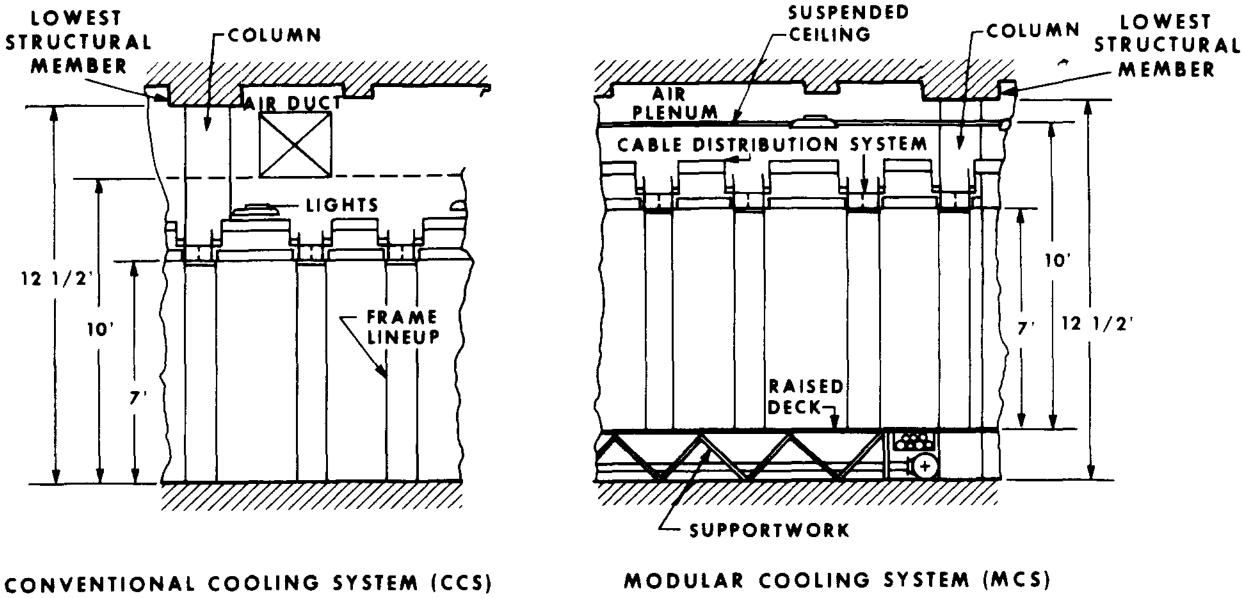


Fig. 2—Typical Equipment Frame Area

7.02 To facilitate building planning and equipment engineering, all bus bars, cables, and racks are expected to be supported by the equipment frames. Over areas lacking frame lineups, via or power cabling weighing up to 5 pounds per square foot may be supported by floor-mounted stanchions or from the ceiling. In multistory buildings, ceiling anchors will be required to support via cable racks, auxiliary framing, air ducts, conduits, and suspended ceilings.

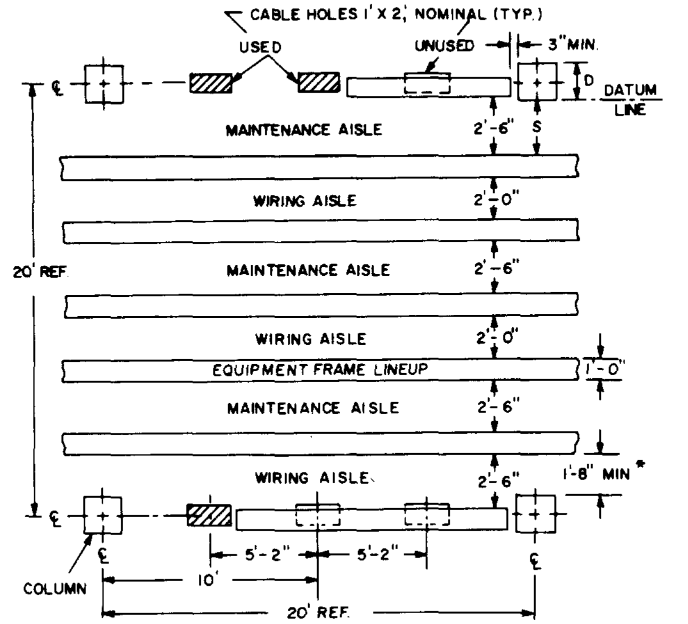
7.03 A basic standard floor plan (Fig. 3) is recommended for all types of equipment. It consists of 12-inch deep frames, with 2-foot 6-inch maintenance aisles and 2-foot wiring aisles. This standard achieves three distinct advantages:

(1) Meets all of the present standard floor plan data sheet rules for minimum aisles for electronic systems.

(2) Repeats every building bay. This modularity is maintained for columns up to 28 inches deep.

(3) Accommodate 18-inch-deep process coolers (used with the MCS) in column lineups of standard layouts.

Alternative standard floor plans are specified for 18-inch and 2-feet deep equipment frames. Layouts also exist for large power plants. By arranging the plants to locate heavier batteries in the same building bays with the lighter distribution boards and charging equipment, an average loading of less than 140 pounds per square foot is achieved, then permitting the power areas to be located anywhere in the building.



COLUMN DEPTH "D"	SPACE AT COLUMN SPACE "S"
1'-10" OR LESS	2'-6"
2'-0"	2'-4"
2'-2"	2'-2"
2'-4" OR GREATER *	2'-0"

*FOR COLUMN DEPTHS GREATER THAN 2'-4", IT MAY BE NECESSARY TO OMIT SOME FRAMES IN THE EQUIPMENT LINEUP OPPOSITE COLUMNS (WIRING AISLE SIDE)

Fig. 3—Standard Floor Plan For Principal Dept (12 Inches) Frame

B. In Existing Buildings

7.04 In the refurbishing of existing building space for new equipment, the application of NEBS equipment and space concepts has been anticipated. The use of modern electronic equipment on 11-foot 6-inch high frameworks can lead to cable congestion and equipment cooling problems. The need for increased cabling space to handle the higher cable densities brought on by circuit compression is in direct conflict with the need for more space to provide higher capacity in the equipment cooling systems originally designed for low electromechanical heat loads. The NEBS concept will eliminate these problems in existing buildings by integrating the equipment cabling and cooling arrangements within 12 feet 6 inches of vertical height. This becomes especially valuable in older electromechanical offices where 13-foot clear ceiling heights were frequently constructed. With the necessary modifications to fit existing building bay dimensions, cable hole locations, and ceiling insert patterns, the use of NEBS standards becomes completely applicable and in most cases, essential to the reuse of existing building space.

7.05 To obtain the benefits in building construction and usage that are forecast for new equipment-building systems, information contained in this section should be employed in the planning and design of new design of new buildings and refurbished space.