DESIGN LOADS FOR TELEPHONE BUILDINGS

GENERAL

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1. GENERAL

1.01 This section covers design standards for floor-carrying capacities including dead, live, and other loads to be used in the design of buildings which house various types of telephone equipment. It also covers design loads for buildings which are used in whole or in part for accounting, business, clerical, and executive offices, and for garages and stockrooms.

1.02 Whenever this section is reissued, the reason(s) for reissue will be listed in this paragraph.

1.03 This practice supersedes Section 760-200-151 and is issued principally to present the New Equipment Building System (NEBS) design loads for equipment buildings.

1.04 Minimum design loads for buildings and other structures are given in local and state building codes, and also in other publications such as American Standard Building Requirements, File A58.1, by the American Standard Association and the National Building Code recommended by the National Board of Fire Underwriters. Telephone buildings, however, require special considerations which normally are not specifically covered by such codes. This section outlines the special loading requirements together with general building design loads.

2. DEFINITIONS

2.01 ***Dead Load*** means the weight of all permanent construction, including walls, framing, roofs, permanent partitions, and stairways of a building.

2.02 ***Live load*** means the load imposed by the occupancy including telephone equipment. It does not include such factors as wind or earthquake loads.

2.03 Buildings, and all parts thereof, are designed and constructed to support safely all loads without exceeding allowable stresses prescribed for the materials of construction in the structural members.

2.04 When an existing building is enlarged, or otherwise altered, all portions thereof affected by such enlargement or alteration are strengthened, if necessary, so that all loads are supported safely without exceeding the allowable stresses.

2.05 Where local and/or state codes, rules, and regulations call for higher requirements than those indicated or implied in this section, such authority takes precedence and its requirements are followed; where the requirements are lower, compliance with the provisions of this section is recommended.

3. DEAD LOADS

3.01 When estimating dead loads for the purpose of design, the actual weights of materials of construction are used.

3.02 Quite commonly, especially in multistory buildings, there are important weight concentrations from vertical runs of building service items such as plumbing stacks and risers, ventilating and air conditioning ducts, and electrical service feeders. These loads, permanently located and carried by structural members, are considered as part of the dead load of the building.

4. LIVE LOADS

4.01 The live loads assumed for the purpose of design are the greatest that are anticipated by the uses contemplated. For NEBS equipment and buildings, these are covered in Section 760-200-021. They are considered to be uniformly distributed except for known heavy concentrations where the locations are fixed. Table A lists the uniform live loads that are adequate for various types of occupancy or use. Because of varying occupancy, the live loading actually imposed may be different on the various bays of a floor. The design engineer will then determine whether to recognize these differences or to design the entire floor uniformly for the heaviest of the expected loads, considering uniformity of construction methods, overall economy, and the uncertainties of future occupancy.

4.02 As noted in Table A, the live loads indicated for cafeterias, locker rooms, local test centers, lounges, and office space which are in permanent locations are less than those required for such areas located in future equipment spaces. Therefore, economics in construction might be affected by taking advantage of these lower load requirements in the design of central office buildings if such areas are located wherever possible in a side building appendage not in line with future equipment growth.

4.03 ***Future or Temporary Loads***—The NEBS uniform live load of 150 pounds per square foot (psf) is somewhat in excess of the loads actually imposed by many items of equipment. This provides a reasonable margin of safety with a minimum amount of special strengthening for NEBS equipment designed to the requirements of Section 800-610-164 and PUB 51001. Likewise, it appears inadvisable to provide further strength to accommodate any possible future increase in weights of equipment, temporary loads of other unforeseen developments, in view of the fact that the total actual live loads will usually be less than these minimum uniformly distributed live loads. In the future, the design of equipment and the floor plan layouts will not exceed these minimum loadings.

4.04 ***Provisions for Movable Partitions***—In buildings where movable partitions might be installed or rearranged, the specified live loads in Table A are usually sufficient to care for such movable partition construction.

4.05 ***Concentrated Loads***—In the design of floors, consideration is given to the effects of known or probable concentration of load to which they may be subjected. Floors are designed to carry the noted distributed loads in Table A or the following minimum concentrations, whichever may produce the greater stresses, and these concentrations are assumed to occupy areas 2-1/2 feet square and to be placed so as to produce maximum stresses in the affected members. Whenever it is necessary to store temporarily or permanently heavy equipment and supplies such as loaded cable reels, etc, it should be spread out to avoid excessive concentration. This is discussed in detail in Section 760-200-021.

LOAD*	FLOOR SPACE
2000 Pounds	Equipment and Nonequipment Including Corridors
Maximum Wheel Load	Garages
Maximum Wheel Load	Trucking Space within a Building

*Increase 50 percent for impact if the exact wheel load for the piece of the equipment is the basis of design. Known concentrated loads such as motor-generator sets, storage batteries, AMA and business machine equipment, and similar loads are considered in each specific case.

4.06 ***Partial Loading***—When the construction is such that the structural elements thereof act together in the nature of an elastic frame due to their continuity and the rigidity of the connections, and the live load exceeds 150 psf or twice the dead load, the effect of partial live load such as will produce maximum stress in any member is provided for in the design.

4.07 ***Impact Loads***—The live loads, listed in Table A may be assumed to include a sufficient allowance to cover the effects of ordinary impact. For special loads involving unusual impacts such as those resulting from elevators, vehicles, etc, provision is made by a suitable increase in the assumed live load.

TABLE A

GENERAL DESIGN LOADS FOR TELEPHONE BUILDINGS

OCCUPANCY OR USE	LIVE LOADS (LBS PER SQ FT)
Corridors	Same as floor occupancy or use. Usually not less than 100.
Electronic Data Processing Equipment	100 (Note 1)
if Raised Floor is Used	90
Card File Storage (slabs)	200 (Note 1)
Card File Storage (beams and girders)	150 (Note 1)
Employee Quarters	
Cafeterias	100 (Note 2)
Kitchens	150 (Note 3)
Locker Rooms	60 (Note 2)
Lounges	60 (Note 2)
Toilet Rooms	Same as floor occupancy or use.
Fire Escapes	100
Garages	
Cars less than 6,000 pounds gross vehicle weight	75 including impact (Note 4)
Trucks 6,000 to 20,000 pounds gross vehicle weight	150 including impact (Note 4)
Trucks over 20,000 pounds gross vehicle weight	250 including impact (Note 4)
Mechanical Plant Areas	
Air Conditioning (machine space)	200 (Note 3)
Boiler Rooms	300 (Note 3)
Elevator Machine Rooms	150 (Note 3)
Fan Rooms	150 (Note 3)
Fuel Rooms	400 (Note 3)
Incinerator Charging Floors	100
Switchboards, Electric	150 (Note 3)
Office Areas	
Accounting, General Space	100 (Note 2)
AMA and Business Machine Equipment	100 (Notes 1 and 2)
Business	100 (Note 2)
Clerical	80-100 (Note 2)
Executive	80-100 (Note 2)
File Rooms	
Letters	80-100 (Notes 1 and 2)
Cards	125 (Note 1)
Addressograph	150 (Note 1)
Public Spaces	100
Stairways	100
Storage	
Light	125 (Note 2)
Heavy	250 (Note 2)
Extra Heavy	300 (Note 2)

TABLE A (Contd)

GENERAL DESIGN LOADS FOR TELEPHONE BUILDINGS

OCCUPANCY OR USE	LIVE LOADS (LBS PER SQ FT)
(NEBS) Telephone Equipment Areas	
Batteries (See Section 760-240-100)	150 (Notes 3 and 5)
Local Test Centers	100 (Note 2)
Main Distributing Frames	150
Operating Rooms	100 (Notes 2 and 6)
Power Equipment	150
Switching and Terminal Equipment	150
Toll Equipment	150
Above Grade	
Vaults	150

Note 1: In machine rooms housing any of the types of data processing machines, a design load of 100 pounds per square foot is usually adequate. In an electronic data processing area, the building structural system is designed to support the 10-pound per square foot (psf) weight of a raised floor (if used) in addition to the equipment loadings on the raised floor specified in Section 4.

Note 2: Use this load for permanent locations and usage. If area is to be used for future telephone equipment or accounting space, use appropriate equipment loading.

Note 3: *Use actual equipment loads if greater.* (See Section 760-200-021.)

Note 4: With the construction of garages or buildings that have open parking on the roof, the suggested 75 psf includes a snow load of 25 psf. In those areas of the country that normally require greater snow loads, additional value for snow should be included, but not 75 psf plus the normal snow load.

Note 5: The NEBS battery plant floor plans are designed for use in buildings with 150 psf live load floors. This includes 140 pounds for batteries, equipment, ducts, and cable; and 10 pounds for people and other transient loads. The placing of the batteries on racks in tiers more than two high is not desirable because of the associated higher temperature range, the maintenance problem, and the fact that their combined weights exceeds design limits. For base slab installations of battery plants, floor plan data sheets are available that show minimum aisle conditions and maximum capacity per square foot of floor area.

Note 6: The construction of the modern position TSP of less weight and elimination of the platform, affords the opportunity to lighten the live load design in operating rooms. The reduction from the former 150 to 100 psf is thus made possible.

4.08 ***Weights of Telephone Equipment***—The preceding paragraphs refer in general to all live loads encountered in telephone buildings. The average weight of installed telephone equipment, exclusive of occupants, temporary loads, etc, is based upon actual weights of the different items of equipment used. Detailed data with regard to weights, together with information concerning spacing of batteries, power equipment, switchboards, testing equipment, switching and terminal equipment, and other apparatus are given in the Floor Plan and Power Data Sheets.

4.09 ***Existing Space***—When planning to use existing space, ***calculate actual live loads to insure safe occupancy.***

Reduction of Live Loads

4.10 ***Columns and Foundations***—The generally accepted practice of using reduced live loadings for the design of columns, piers, foundations, or bearing walls in multistory buildings is recognized and permitted by most building codes. It is based on the logical assumption that most types of occupancy will never load all bays of all floors to their maximum designed load at the same time. Various codes use different formulas for applying the reduction to different types of construction so it is not feasible to state a method of arriving at the reduced loads that will meet the requirements of all cities.

4.11 Studies made on fully occupied télephone equipment buildings, however, show a much closer approximation of actual loads to the design load in the various bays than in an office building. This indicates that load reduction for column and foundation designs should be rather carefully handled in equipment buildings. The following procedures are recommended:

(1) No live load reduction in buildings of three stories or less.

(2) In taller buildings, the formulas of the local building codes may be followed ***except*** that no reduction should be greater than 30 psf.

4.12 In office buildings, as contrasted with equipment buildings, the likelihood of underloading in many bays should permit taking full advantage of the reductions permitted by local codes for column and foundation design.

4.13 ***Beams and Girders***—It is suggested that no reduction of live loads for use in design of girder members, even when allowed by local building codes, be applied in the design of telephone buildings as it appears that no appreciable economy is effected.

Roof Loads

4.14 Design loads for roofs, either flat or pitched, include the dead load of the roof along with wind, earthquake, and snow loads. All of these loadings vary greatly in the different areas and climates; however, they are all considered and the loadings are adopted that are in accordance with local practice and building codes.

4.15 Roofs to be used for special purposes, such as locations for lens and various types of antennas, are designed for the appropriate loads.

4.16 Where the floor immediately below the roof is planned for initial or future telephone equipment, the roof shall be designed for the additional live load imposed by the cables and auxiliary framing and shall have sufficient thickness and strength to receive on its underside the ceiling inserts and other fittings necessary for the support of the cables and the auxiliary framing. The weight of this cabling and its auxiliary framing is approximately 25 psf.

Other Live Loads

4.17 ***Stairways***—Inside and outside stair treads and landings are designed to support a uniformly distributed live load of 100 psf or concentrated loads of 300 pounds spaced 3 feet center to center, each occupying an area of 1 foot wide by the depth of the tread, whichever will produce the greater stress. A safety factor of 4 is used for inside stairways, and a safety factor of 6 is used for outside stairways on the basis that outside steel stairways being exposed to the elements are subjected to possible weakening through corrosion.

4.18 ***Accessible ceilings, scuttles, and ribs of skylights*** are designed to support a concentrated load of 200 pounds occupying an area 2-1/2 feet square and so placed as to produce maximum stresses in the affected members.

4.19 ***Stairway and balcony railings,*** both inside and outside, are designed to resist a horizontal thrust of 50 pounds per linear foot applied at the top of the railing.

Floor Load Data

4.20 Floor plans showing the weights and general plan dimensions of initial and future telephone equipment are given the architect in the design stage of a new building, or of an addition to an existing building, in order to verify that the basic live loads of 150 psf, used in the initial planning are adequate for the conditions of actual loading.

5. SOIL AND HYDROSTATIC PRESSURES

5.01 ***Pressure on Basement Walls***—In the design of basement walls and similar approximately vertical structures below grade, provision is made for the lateral pressure of adjacent soil. Due allowance is made for possible surcharge from fixed or moving loads. When a portion, or the whole, of the adjacent soil is below a free-water surface, computations are based on the weight of the soil diminished by buoyancy, plus full hydrostatic pressure.

5.02 ***Uplift on Floors***—In the design of basement floors and similar approximately horizontal construction below grade, the upward pressure of water, or adverse soil conditions such as expansive clays, if any, is taken as the full hydrostatic pressure applied over the entire area. The hydrostatic head is measured from the underside of the construction.

6. WIND PRESSURES

6.01 Buildings are designed and constructed to withstand horizontal pressures caused by wind from any direction including pressure by cyclones, hurricanes, or tornadoes where applicable as covered in Section 760-200-022. The design should take into consideration wind pressures that prevail for the particular location and height of the building.

6.02 Every exterior wall is designed and constructed to withstand such wind pressures acting either inward or outward.

6.03 ***Roofs:***

(a) The roof of all buildings are designed and constructed to withstand wind pressures acting outward normal to the surface.

(b) Roofs or sections of roofs with slopes greater than 30 degrees are designed and constructed to withstand wind pressures acting inward normal to the surface and applied to the windward slope only with outward pressure acting on the leeward slope.

(c) Overhanging eaves and cornices are designed and constructed to withstand outward and upward wind pressures.

(d) Adequate anchorage of the roof to walls and columns, and of walls and columns to the foundation to resist overturning, uplift, and sliding, is provided in all cases.

6.04 ***Chimneys***—Chimneys, tanks, and towers are designed and constructed to withstand wind pressures and earthquake loads.

6.05 ***Shielding and Unusual Exposures***—No allowance is made for the shielding effect of other buildings.

6.06 ***Stresses During Construction***—Provisions are made for wind stress during the construction of a building.

7. EARTHQUAKE LOADS

7.01 Earthquake loads are lateral loads, the magnitude of the load being a function of the shape and mass of the structure and its geographical location. Design standards for earthquake loads are covered in Section 760-200-023.

7.02 Formulas for determination of seismic loads are generally based upon the recommendations of the Structural Engineers Association of California. Lateral Force Code provisions of the Uniform Building Code, and of the American Standard Association are both based upon these recommendations. Building configuration and type of construction are two major factors which determine the earthquake loads to be used for the design of the building under these codes. The mass of the building and its geographical location are also major factors.

7.03 Unless local Building Codes are more restrictive, the current uniform Building Code or ASA Code (whichever is of the latest date) should be used as the minimum standard for a seismic design.

7.04 In determining the mass of the building to be used in seismic code formulas, it must be recognized that all central office equipment buildings and all toll buildings are designed to contain heavy masses of equipment and that the live loads used in the design of such buildings are correspondingly heavy. Of the total design live load, 10 psf is included for transient loads; the remainder is for equipment and cabling. Since the entire floor area is not covered by equipment, the proportion of the design live load to be added to dead load in determining earthquake forces shall be 50 percent of the design live load less 10 psf. Thus, for a floor designed for a live load of 150 psf, 65 psf is to be used as equivalent dead load in the seismic code formulations for lateral load effects, ie, 0.5 (150) - 10 = 65 psf. For the case where overhead bracing is used to provide lateral support to the equipment, the building elements that support such bracing shall be designed to accommodate the computed loadings caused by seismic effects. Where such computed loads are not available, the horizontal component of the loading on the building elements to which the bracing is connected shall be taken to be equal to one-half of the ***total*** weight of equipment laterally supported by the bracing. In office areas, where telephone equipment is not used, the proportion of live load to be used as equivalent dead load for seismic calculations shall be taken as 25 percent. However, all dead loads in such areas, such as partition loadings, shall be taken at full value. Thus, a floor designed for a 20 psf partition load plus 80 psf live loading, 40 psf is to be used as equivalent dead load in the seismic code formulations for lateral load effects, ie, 20 + 0.25 (80) = 40 psf.

7.05 It must be recognized that all masonry or concrete walls in a building are relatively stiff, and that earthquake loads are resisted by the elements of the building which have such stiffness in proportion to that stiffness rather than their strength; therefore, it is imperative to design proper strength into these stiff elements. The frame of the building is unable to receive lateral loads as long as stiff walls or bracing are present and functioning. However, if the stiff wall or bracing elements should fail under seismic load, a secondary line of defense against lateral loads will be the building frame.

7.06 Other factors to be considered by the designer of the structure are torsional problems where earthquake loads do not have close match between load centroids and resistance centroids; effects of setbacks or other major offsets in a building plan; and variations in foundation material. Buildings should be generally founded on comparable soils since earthquake shocks frequently affect buildings in the same area differently, depending upon the soils the buildings are founded on.

7.07 Buildings designed for lateral growth need careful attention in seismic design. Since building floors and roofs are horizontal diaphragms delivering earthquake loads to the vertical resisting elements, provision should be made for proper splicing of diaphragm chords at the time of additional construction. It must also be recognized that a shear transfer problem exists in these diaphragms at the line where the addition is joined.

8. NUCLEAR EFFECTS LOADS

8.01 Planning for the survival of critical transmission facilities involves several combinations of three primary techniques:

(1) Alternate routing flexibility by distributing communications services throughout a web of physical facilities.

(2) Locating installations away from such possible target areas as cities and military installations.

(3) When facilities must be within "danger" areas, constructing buildings in such a way as to "harden" them against the effects of a nuclear attack.

8.02 Since the network already includes such measures as diversified routing and alternate route selection, which help to assure continuity of service, new facilities of the radio and cable network must be studied to arrive at the best combination of separation distance and hardened construction that will satisfy survival objectives.

8.03 Design standards for nuclear effects loads or facilities are contained in Section 760-200-024.