DESIGN LOADS FOR TELEPHONE BUILDINGS

CONTENTS

1. GENERAL

1.01 This section covers recommendation for assumption of 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 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 these special loading requirements together with general building design loads.

1.03 ***Definitions***

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

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

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

1.05 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 proper allowable stresses.

1.06 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.

1.07 This section is revised to bring the live load recommendations up to date because of changes in telephone equipment and experience with actual loading conditions of buildings. The most important changes are:

(1) Lighter design loads for operating rooms.

(2) The addition of design loads for electronic data processing machines.

(3) Somewhat amplified notes on battery room loads.

(4) More conservative recommendations regarding advisable reductions in live loading for column design.

1.08 Marginal arrows are used to indicate a change in the text.

2. DEAD LOADS

2.01 When estimating dead loads for the purposes of design, the actual weights of materials and construction are used. In the absence of definite information, values are assumed which are satisfactory to the authority charged with the administration and enforcement of the local building code.

2.02 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.

3. LIVE LOADS

3.01 The live loads assumed for the purpose of design are the greatest that probably will be produced by the uses contemplated. They are considered to be uniformly distributed except for known heavy concentrations where the locations are fixed. The following table lists the uniform live loads that are adequate for various types of occupancy or use. Quite frequently, because of varying occupancy, the live loading actually required will be different on the various bays of a floor. The design engineer will then exercise his best judgment, whether to recognize these differences or to design the entire floor uniformly for the heaviest of the expected loads considering uniformity of construction methods, over-all economy, and the uncertainties of future occupancy.

OCCUPANCY OR USE	LIVE LOADS LBS. PER SQ. FT.
Corridors	
Permanent	Same as floor occupancy or use.
Temporary	Usually not less than 100.
Electronic Data Processing Equipment	100 (4)
If Raised Floor is Used	70 (4)
Card File Storage (when not over framing member)	200 (4)
Card File Storage (when over framing member)	150 (4)
Employee Quarters	
Cafeterias	100 (1)
Kitchens	150 (2)
Locker Rooms	60 (1)
Lounges	60 (1)
Toilet Rooms	Same as floor occupancy or use.
Fire Escapes	100
Garages	
Cars, less than 6000 pounds gross vehicle weight	100
Trucks 6000 to 20,000 pounds gross vehicle weight	150
Trucks over 20,000 pounds gross vehicle weight	250
Mechanical Plant Areas	
Air Conditioning (machine space)	200 (2)
Boiler Rooms	300 (2)
Elevator Machine Rooms	150 (2)
Fan Rooms	150 (2)
Fuel Rooms	400
Incinerator Charging Floors	100
Switchboards, Electric	150 (2)

OCCUPANCY OR USE	LIVE LOADS LBS. PER SQ. FT.
Office Areas	
Accounting, General Space	100 (1)
AMA and Business Machine Equipment	100 (2)
Business	100 (1)
Clerical	80 (1)
Executive	80 (1)
File Rooms	
Letters	80 (3)
Cards	125 (3)
Addressograph	150 (3)
Public Spaces	100
Stairways	100
Storage	
Light	125 (3)
Heavy	250 (3)
Extra Heavy	300 (3)
Telephone Equipment Areas	
Batteries	175-300 (2) (6)
Local Test Centers	100 (1)
Main Distributing Frames	175 (2)
Operating Rooms	100 (1) (5)
Power Equipment	175 (2)
Switching and Terminal Equipment (Excluding Main Distributing Frames)	150 (2)
Vaults	250 (3)

Notes: (1) Use this load for permanent locations; where in future telephone equipment space, use appropriate equipment loading.

(2) Use actual equipment loads if greater.

(3) Increase when present or future use exceeds this amount.

(4) In machine rooms housing any of the types of data processing machines, a design load of 100 pounds per square foot is usually adequate.

Where an electronic data processing machine room is provided with a raised false floor to accommodate cabling and ducts, a design live load of 70 pounds per square foot is adequate because the raised floor distributes loading to the structural slab much more uniformly than when the various computer cabinets or machines are placed directly on the slab.

Areas for card storage files would be afforded complete flexibility by a design load of 200 pounds per square foot. If the files can be located close to some of the framing members, the live load on the slab may be reduced to 150 pounds per square foot.

(5) The construction of the modern switchboard 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 pounds to 100 pounds per square foot is thus made possible.

Notes: (Cont'd) (6) The battery space in telephone equipment areas presents the problem of heavy concentration and is amplified by the number of central offices being served. Batteries currently in use range in weight from 415 pounds to 1715 pounds and as previously mentioned presents the problem of concentrated loads. The placing of the lighter weight 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 soon approximates the weight of the heavier batteries. The bays assigned for battery location are, as a rule, fully utilized and consequently should not be designed below the most severely anticipated live load usage.

3.02 Experience has shown that an assumed uniformly distributed live load of 175 pounds per square foot for main distributing frames is normally required to safely support this type of loading, occupancy and use of the area.

3.03 It will be noted that in the table in Paragraph 3.01 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 space. Therefore, economies 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.

3.04 ***Future or Temporary Loads:*** The uniform live loads of 150 and 175 pounds per square foot are somewhat in excess of the loads actually imposed by many items of equipment, but are believed to provide reasonable margins of safety with a minimum amount of special strengthening. 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. It is contemplated that in the future, the design of equipment and the floor plan layouts will not exceed these minimum loadings.

3.05 ***Provisions for Movable Partitions:*** In buildings where movable partitions might be installed or rearranged, the specified live loads in the table in Paragraph 3.01 are usually sufficient to care for such movable partition construction.

3.06 ***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 under Paragraph 3.01 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.

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

* Increase 50% for impact if the exact wheel load for the piece of the equipment is the basis of design.

As indicated in Paragraphs 3.01 and 3.18, known concentrated loads such as equipment frames, motor-generator sets, storage batteries, AMA and business machine equipment, and similar loads are considered in each specific case.

3.07 ***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 pounds per square foot 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.

3.08 ***Impact Loads:*** The live loads listed in Paragraph 3.01 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.

3.09 ***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 Standard Floor Plan Data Sheets issued by the Bell Telephone Laboratories, Inc.

Reduction of Live Loads

3.10 ***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.

Studies made on fully occupied telephone equipment buildings, however, show a much closer approximation of actual loads to the design load in the various bays than is the case in, say, an office building. This indicates that load reduction for column and foundation designs should be rather carefully handled in equipment buildings and 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 below a minimum of 115 pounds per square foot.

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.

3.11 ***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

3.12 Design loads for roofs either flat or pitched include the dead load of the roof; wind or earthquake loads whichever is the longer; and snow loads. All of these loadings vary greatly in different areas and climates but they are all considered and loadings adopted that are in accord with local practice and building codes.

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

Other Live Loads

3.14 ***Stairways:*** Inside and outside stair treads and landings are designed to support a uniformly distributed live load of 100 pounds per square foot 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.

3.15 ***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.

3.16 ***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

3.17 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 determine that the basic live loads of 150 and 175 pounds per square foot, probably used in the initial planning, are adequate for the conditions of actual loading.

4. SOIL AND HYDROSTATIC PRESSURES

4.01 ***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.

4.02 ***Uplift on Floors:*** In the design of basement floors and similar approximately horizontal construction below grade, the upward pressure of water, 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.

5. WIND PRESSURES

5.01 Buildings are designed and constructed to withstand horizontal pressures caused by wind from any direction including pressure by cyclones, hurricanes, or tornadoes where applicable.

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

5.03 ***Roofs***

(a) The roofs 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.

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

5.04 ***Chimneys:*** Chimneys, tanks, and towers are designed and constructed to withstand wind pressures.

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

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

6. EARTHQUAKE LOADS

6.01 In general, every building is designed and constructed to withstand some lateral load from any horizontal direction.

6.02 Every building in localities where earthquakes of major or near major intensities are experienced, is designed and constructed to withstand a minimum lateral load from any horizontal direction as prescribed by local building codes.

6.03 In every building having a skeleton frame, such frame is designed and constructed to

withstand a certain percentage of the force specified for the building itself in accordance with local building codes, without assistance from any walls or floors. By skeleton frame is meant a framework consisting of columns, girders, beams, and similar members supporting and transmitting all loads to foundations.

6.04 Reinforced concrete or masonry walls and all other permanent structural elements capable of providing resistance are assumed to act integrally with the structural frames in resisting the shears and movements due to the specified horizontal force, unless specifically designed and constructed to act independently.