

# Chapter C4

## LIVE LOADS

### C4.3 UNIFORMLY DISTRIBUTED LIVE LOADS

#### C4.3.1 Required Live Loads

A selected list of loads for occupancies and uses more commonly encountered is given in Section 4.3.1, and the authority having jurisdiction should approve on occupancies not mentioned. Tables C4-1 and C4-2 are offered as a guide in the exercise of such authority.

In selecting the occupancy and use for the design of a building or a structure, the building owner should consider the possibility of later changes of occupancy involving loads heavier than originally contemplated. The lighter loading appropriate to the first occupancy should not necessarily be selected. The building owner should ensure that a live load greater than that for which a floor or roof is approved by the authority having jurisdiction is not placed, or caused or permitted to be placed, on any floor or roof of a building or other structure.

To solicit specific informed opinion regarding the design loads in Table 4-1, a panel of 25 distinguished structural engineers was selected. A Delphi (Corotis et al. 1981) was conducted with this panel in which design values and supporting reasons were requested for each occupancy type. The information was summarized and recirculated back to the panel members for a second round of responses. Those occupancies for which previous design loads were reaffirmed, as well as those for which there was consensus for change, were included.

It is well known that the floor loads measured in a live-load survey usually are well below present design values (Peir and Cornell 1973, McGuire and Cornell 1974, Sentler 1975, and Ellingwood and Culver 1977). However, buildings must be designed to resist the maximum loads they are likely to be subjected to during some reference period  $T$ , frequently taken as 50 years. Table C4-2 briefly summarizes how load survey data are combined with a theoretical analysis of the load process for some common occupancy types and illustrates how a design load might be selected for an occupancy not specified in Table 4-1 (Chalk and Corotis 1980). The floor load normally present for the intended functions of a given occupancy is referred to as the sustained load. This load is modeled as constant until a change in tenant or

occupancy type occurs. A live-load survey provides the statistics of the sustained load. Table C4-2 gives the mean,  $m_s$ , and standard deviation,  $\sigma_s$ , for particular reference areas. In addition to the sustained load, a building is likely to be subjected to a number of relatively short-duration, high-intensity, extraordinary, or transient loading events (due to crowding in special or emergency circumstances, concentrations during remodeling, and the like). Limited survey information and theoretical considerations lead to the means,  $m_t$ , and standard deviations,  $\sigma_t$ , of single transient loads shown in Table C4-2.

Combination of the sustained load and transient load processes, with due regard for the probabilities of occurrence, leads to statistics of the maximum total load during a specified reference period  $T$ . The statistics of the maximum total load depend on the average duration of an individual tenancy,  $\tau$ , the mean rate of occurrence of the transient load,  $v_e$ , and the reference period,  $T$ . Mean values are given in Table C4-2. The mean of the maximum load is similar, in most cases, to the Table 4-1 values of minimum uniformly distributed live loads and, in general, is a suitable design value.

For library stack rooms, the 150 psf (7.18 kN/m<sup>2</sup>) uniform live load specified in Table 4-1 is intended to cover the range of ordinary library shelving. The most important variables that affect the floor loading are the book stack unit height and the ratio of the shelf depth to the aisle width. Common book stack units have a nominal height of 90 in. (2,290 mm) or less, with shelf depths in the range of 8 in. (203 mm) to 12 in. (305 mm). Book weights vary, depending on their size and paper density, but there are practical limits to what can be stored in any given space. Book stack weights also vary, but not by enough to significantly affect the overall loading. Considering the practical combinations of the relevant dimensions, weights, and other parameters, if parallel rows of ordinary double-faced book stacks are separated by aisles that are at least 36 in. (914 mm) wide, then the average floor loading is unlikely to exceed the specified 150 psf (7.18 kN/m<sup>2</sup>), even after allowing for a nominal aisle floor loading of 20 to 40 psf (0.96 to 1.92 kN/m<sup>2</sup>).

The 150 psf floor loading is also applicable to typical file cabinet installations, provided that the 36-in. minimum aisle width is maintained. Five-drawer lateral or conventional file cabinets, even with