pattern loading should be considered regardless of the magnitude of the uniform load. Cantilevers must not rely on a possible live load on the anchor span for equilibrium.

C4.4 CONCENTRATED LIVE LOADS

The provision in Table 4-1 regarding concentrated loads supported by roof trusses or other primary roof members is intended to provide for a common situation for which specific requirements are generally lacking.

Primary roof members are main structural members such as roof trusses, girders, and frames, which are exposed to a work floor below, where the failure of such a primary member resulting from their use as attachment points for lifting or hoisting loads could lead to the collapse of the roof. Single roof purlins or rafters (where there are multiple such members placed side by side at some reasonably small center-to-center spacing, and where the failure of a single such member would not lead to the collapse of the roof) are not considered to be primary roof members.

Helipads. These provisions are added to the standard in 2010. For the standard, the term "helipads" is used to refer specifically to the structural surface. In building codes and other references, different terminology may be used when describing helipads, e.g., heliports, helistops, but the distinctions between these are not relevant to the structural loading issue addressed in ASCE 7.

Although these structures are intended to be specifically kept clear of non-helicopter occupant loads on the landing and taxi areas, the uniform load requirement is a minimum to ensure a degree of substantial construction and the potential to resist the effects of unusual events.

Concentrated loads applied separately from the distributed loads are intended to cover the primary helicopter loads. The designer should always consider the geometry of the design basis helicopter for applying the design loads. A factor of 1.5 is used to address impact loads (two single concentrated loads of 0.75 times the maximum take-off weight), to account for a hard landing with many kinds of landing gear. The designer should be aware that some helicopter configurations, particularly those with rigid landing gear, could result in substantially higher impact factors that should be considered.

The 3000-lb (13.35-kN) concentrated load is intended to cover maintenance activities, similar to the jack load for a parking garage.

Additional information on helipad design can be found in International Civil Aviation Organization (1995). Note that the Federal Aviation Administration provides standards for helicopter landing pads, including labeling for weight limitations (U.S. Department of Transportation 2004).

C4.5 LOADS ON HANDRAIL, GUARDRAIL, GRAB BAR, AND VEHICLE BARRIER SYSTEMS, AND FIXED LADDERS

C4.5.1 Loads on Handrail and Guardrail Systems

Loads that can be expected to occur on handrail and guardrail systems are highly dependent on the use and occupancy of the protected area. For cases in which extreme loads can be anticipated, such as long straight runs of guardrail systems against which crowds can surge, appropriate increases in loading shall be considered.

C4.5.2 Loads on Grab Bar Systems

When grab bars are provided for use by persons with physical disabilities, the design is governed by CABO A117.1 *Accessible and Usable Buildings and Facilities*.

C4.5.3 Loads on Vehicle Barrier Systems

Vehicle barrier systems may be subjected to horizontal loads from moving vehicles. These horizontal loads may be applied normal to the plane of the barrier system, parallel to the plane of the barrier system, or at any intermediate angle. Loads in garages accommodating trucks and buses may be obtained from the provisions contained in AASHTO (1989).

C4.5.4 Loads on Fixed Ladders

This provision was introduced to the standard in 1998 and is consistent with the provisions for stairs.

Side rail extensions of fixed ladders are often flexible and weak in the lateral direction. OSHA (CFR 1910) requires side rail extensions, with specific geometric requirements only. The load provided was introduced to the standard in 1998 and has been determined on the basis of a 250-lb person standing on a rung of the ladder, and accounting for reasonable angles of pull on the rail extension.

C4.6 IMPACT LOADS

Grandstands, stadiums, and similar assembly structures may be subjected to loads caused by crowds