and Madsen 1980). This is consistent with the manner in which loads actually combine in situations in which strength limit states may be approached. However, nominal loads in this standard are substantially in excess of the arbitrary point-in-time values. To avoid having to specify both a maximum and an arbitrary point-in-time value for each load type, some of the specified load factors are less than unity in combinations 2 through 6. Load factors in Section 2.3.2 are based on a survey of reliabilities inherent in existing design practice (Ellingwood et al. 1982 and Galambos et al. 1982).

The load factor on wind load in combinations 4 and 6 has been reduced from 1.6 in ASCE 7-05 to 1.0 in ASCE 7-10. This reduction is necessary because of the change in the specification of the design wind speed in Chapter 26. As explained in the Commentary to Chapter 26, the wind speed now is mapped at much longer return periods (700 to 1,700 years, depending on Risk Category) than in previous editions of the Standard, eliminating the discontinuity in risk between hurricane-prone coastal areas and the remainder of the country and better aligning the treatment of wind and earthquake effects.

Exception (2) permits the companion load *S* appearing in combinations (2), (4), and (5) to be the balanced snow load defined in Sections 7.3 for flat roofs and 7.4 for sloped roofs. Drifting and unbalanced snow loads, as principal loads, are covered by combination (3).

Load combinations 6 and 7 apply specifically to the case in which the structural actions due to lateral forces and gravity loads counteract one another.

Load combination requirements in Section 2.3 apply only to strength limit states. Serviceability limit states and associated load factors are covered in Appendix C of this standard.

This standard historically has provided specific procedures for determining magnitudes of dead, occupancy live, wind, snow, and earthquake loads. Other loads not traditionally considered by this standard may also require consideration in design. Some of these loads may be important in certain material specifications and are included in the load criteria to enable uniformity to be achieved in the load criteria for different materials. However, statistical data on these loads are limited or nonexistent, and the same procedures used to obtain load factors and load combinations in Section 2.3.2 cannot be applied at the present time. Accordingly, load factors for fluid load (*F*) and lateral pressure due to soil and water in soil (*H*) have been chosen to yield designs that would be similar to those obtained with existing specifications, if appropriate adjustments consistent with the load combinations in Section 2.3.2 were made to the resistance factors. Further research is needed to develop more accurate load factors.

Fluid load, *F*, defines structural actions in structural supports, framework, or foundations of a storage tank, vessel, or similar container due to stored liquid products. The product in a storage tank shares characteristics of both dead and live loads. It is similar to a dead load in that its weight has a maximum calculated value, and the magnitude of the actual load may have a relatively small dispersion. However, it is not permanent; emptying and filling causes fluctuating forces in the structure; the maximum load may be exceeded by overfilling; and densities of stored products in a specific tank may vary.

The fluid load is included in the load combinations where its effects are additive to the other loads (load combinations 1 through 5). Where *F* acts as a resistance to uplift forces, it should be included with dead load *D*. The mass of the fluid is included in the inertial effect due to *E* (see Section 15.4.3) and the base shear calculations for tanks (Section 15.7). To make it clear that the fluid weight in a tank can be used to resist uplift, *F* was added to load combination 7, where it will be treated as dead load only when *F* counteracts *E*. The fluid mass effects on stabilization depend on the degree to which the tank is filled. *F* is not included in combination 6 because the wind load can be present whether the tank is full or empty, so the governing load case in combination 6 is when *F* is zero.

Uncertainties in lateral forces from bulk materials, included in *H*, are higher than those in fluids, particularly when dynamic effects are introduced as the bulk material is set in motion by filling or emptying operations. Accordingly, the load factor for such loads is set equal to 1.6.

Where *H* acts as a resistance, a factor of 0.9 is suggested if the passive resistance is computed with a conservative bias. The intent is that soil resistance be computed for a deformation limit appropriate for the structure being designed, not at the ultimate passive resistance. Thus an at-rest lateral pressure, as defined in the technical literature, would be conservative enough. Higher resistances than at-rest lateral pressure are possible, given appropriate soil conditions. Fully passive resistance would likely not ever be appropriate because the deformations necessary in the soil would likely be so large that the structure would be compromised. Furthermore, there is a great uncertainty in the nominal value of passive resistance, which would also argue for a lower factor on *H* should a conservative bias not be included.