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MAJOR UPDATES TO SNOW LOAD DESIGN IN ASCE 7-22

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The 2022 edition of ASCE 7 (ASCE 7-22), which forms the basis for load requirements in the 2024 International Building Code (IBC), introduced the most significant changes to snow load requirements since the standard's inception. Key revisions include the adoption of reliability-targeted, ultimate ground snow loads based on an expanded national dataset. ASCE 7-22 replaces the previous use of a single ground snow load map and importance factors with separate maps for each building Risk Category, allowing for more precise and risk-appropriate design values. This shift aligns with similar updates made to wind load provisions in ASCE 7-10 and mirrors the approach used for other environmental loads. These updates, among others, have resulted in substantial increases in ground snow loads for some regions, modifications to snow load development calculations, adjustments to ASD and LRFD load combinations, and revisions to seismic weight calculations. Consequently, engineers must adapt their design practices to incorporate these new ground snow load maps, consider additional parameters such as the winter wind factor and updated thermal factors, and address potentially higher structural demands in affected areas. At the same time, miscommunication in specifications during the transition period, when older versions of the standard are still in wide use, is likely. This article outlines the key revisions to snow load provisions and discusses their practical implications for engineers, building officials, and the design of structures.

Why the change?

Earlier versions of ASCE 7 specified ground snow load using a uniform-hazard approach with a 50-year mean recurrence interval (MRI) and a 1.6 load factor (load and resistance factor design, LRFD) based on available historical data. Building design criteria under this method focused on the probability of a snow event exceeding the predicted snow loads. This resulted in nonuniform roof reliability, leading to under-designed roofs in some regions and over-designed roofs in others. This inconsistency in reliability meant that the level of safety against snow-induced collapse varied significantly across the nation, despite adherence to the same standard. Furthermore, the uniform-hazard approach didn't directly correlate the predicted ground snow load to the actual structural capacity of the roof, potentially leading to inefficient use of materials and resources.

The move to a reliability-targeted approach in ASCE 7-22 addresses these inconsistencies by directly linking the design snow load to an acceptable probability of structural failure. This provides a more consistent level of safety for all building occupancies nationwide, ensuring that the likelihood of collapse due to snow loads is more uniform. The revised ground snow load maps incorporate 30 additional years of weather data, increasing accuracy and significantly reducing case-study areas.

Changes that affect everyday calculations

Designers will now use separate ultimate ground snow loads for each risk category. The site-specific values can be found at https://ascehazardtool.org.

Designers will spend less time searching for snow load data in case-study areas. Ground snow load values are available for most areas. The number of case-study regions has been reduced by approximately 90%.

The snow load factor is reduced to 1.0 in LRFD load combinations and to 0.7 in ASD load combinations (for example: 1.2D+1.0S (LRFD), 1.0D+0.7S (ASD)).

The snow importance factor, I_s , has been removed from all equations.

The thermal factor, C_t , criteria have been updated. Table 7.3-3, found in ASCE 7-22, shows new thermal factors for different insulation and ground snow load scenarios for heated structures with unventilated roofs.

The minimum snow load, p_m, criteria have changed. A new table showing the upper limit of minimum snow load, $p_{m,max}$ has been added, providing specific values for each risk category.

Unbalanced snow load and snow drift provisions have been revised. A Winter Wind Parameter, W_2, defined as percent of time wind speed is above 10 mph during winter (ASCE 7-22, Figure 7.6-1), is incorporated into the equations, making drift calculations more location-specific.

Rain-on-snow surcharge load provisions have been updated to address new ultimate snow load values.

Snow load changes also impact seismic load calculations. Specifically, when the flat roof snow load exceeds 45 psf, 15% of the uniform design snow load must be added to the effective seismic weight. In ASCE 7-16, these parameters were 30 psf and 20%, respectively.

Potential for miscommunication and errors

The updated snow load requirements in ASCE 7-22 introduce several potential areas for miscommunication among engineers, building officials, and designers.

- **Different Interpretations of Load Values:** Some professionals may mistakenly use old ground snow load values or fail to distinguish between ultimate and service-level loads, particularly since both are still referenced in various codes and design programs.
- **Software and Calculation Updates:** Design software and calculation templates may not be updated immediately, leading to discrepancies in applied loads or missed new requirements. Selecting the correct version of the ASCE 7 standard in design software has become even more critical.
- **ASCE 7-22 standard with 2021 IBC or older codes:** While ASCE 7-22 forms the basis for the 2024 International Building Code, adoption timelines vary by state and jurisdiction. Earlier IBC model codes reference ASCE 7-16 or older versions. Some states, like Florida and Virginia, still operating under the 2021 International Building Code have already adopted ASCE 7-22. The designer should review all state and local amendments to confirm which version of ASCE 7 is required for a specific project.

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ASCE 7-16 vs. ASCE 7-22 Snow load example

The practical distinctions between the two versions of the standard are demonstrated in this example.

Design Criteria:

- Shop building (Risk Category II)
- Ventilated flat roof with R-25 insulation or better
- ASCE 7-16 Thermal factor, $C_t = 1.1$ (ASCE 7-16, Table 7.3-2)
- ASCE 7-22 Thermal factor, $C_t = 1.2$ (ASCE 7-22, Table 7.3-2)
- ASCE 7-16 Snow load importance factor, $I_s = 1.0$
- ASCE 7-22 Snow load importance factor, I_s = N/A
- Exposure factor, $C_e = 1.0$
- Dead load on roof, D = 10 psf
- Flat roof snow load, ASCE 7-16: $pf = 0.7\ C_e\ C_t\ I_s\ p_g$ (ASCE 7-16, Eq. 7.3-1)
- Flat roof snow load, ASCE 7-22: $pf = 0.7\ C_e\ C_t\ p_g$ (ASCE 7-22, Eq. 7.3-1)

Table 1 summarizes the results of this example for four different cities. In three out of the four cities, the roof snow load calculated using ASCE 7-22 increased by 25% to 53% compared to ASCE 7-16 standard. This increase is attributed to two specific design factors which have changed in ASCE 7-22:

1. **Higher Ground Snow Loads:** The ground snow loads, even when converted from the ultimate to ASD levels, have increased at the three selected locations.
2. **Increased Thermal Factor:** The thermal factor for ventilated roofs has increased.

The example in Minneapolis, however, demonstrates a decrease in roof snow load, despite the increase in the thermal factor.

Summary and Conclusion

The move to reliability-targeted ultimate ground snow loads, incorporating an expanded dataset and risk-specific mapping, addresses the inherent inconsistencies of the previous uniform-hazard method. These changes ensure more consistent structural safety nationwide, improved accuracy in load determination, and a significantly reduced number of case-study areas. The changes are significant and create a strong potential for miscommunication between old ground snow loads with a 1.6 load factor, and new ultimate ground snow loads with 1.0 load factor. Specifically, using old ground snow loads with new load factors is a critical error that will result in severely under-designed buildings. Verifying that the correct version of ASCE 7 is selected in design programs is now even more important. The safe and effective application of these major updates hinges on staying informed, promptly adjusting design practices and software, and maintaining strong, clear communication among all professionals involved in the design process.

Table 1: Example of snow loads on flat roofs using ASCE 7-16 and ASCE 7-22 specifications

Location	Dead Load	Ground Snow Load		Roof Snow Load		ASD Load Combinations		Change *(positive value indicates increase)*
		ASCE 7-16	ASCE 7-22	ASCE 7-16	ASCE 7-22	ASCE 7-16 D+S	ASCE 7-22 D+0.7S	
	(psf)	(psf)	(psf)	(psf)	(psf)	(psf)	(psf)	%
Baltimore, MD	10	25	59	19.3	49.6	29.3	44.7	53%
Boston, MA	10	40	65	30.8	54.6	40.8	48.2	18%
Detroit, MI	10	20	37	15.4	31.1	25.4	31.8	25%
Minneapolis, MN	10	50	58	38.5	48.7	48.5	44.1	-9%