WABO/SEAW Liaison Committee Washington Association of Building Officials & Structural Engineers Association of Washington	**WHITE PAPER 8-2021**

Title: Guidelines for snow load design in Washington State.	**Date: December 9, 2010** **Issue Date: January 31, 2021**
Abstract: This white paper is intended to be a guideline for establishing a uniform approach to determining minimum ground snow loads, p_g, and roof snow loads, p_f, and other roof design considerations.	**Committee Members:** *Matt Snook (SEAW Co-chair), Lee Kranz (WABO Co-Chair), Shalini Prochazka (SEAW), Nancy Devine (WABO), Larry Lindell (SEAW), Rick Fine (SEAW), Mary Kate McGee (WABO), Cheryl Burwell (WABO), Chris Ricketts (WABO), Steve Belzak (WABO), Charlie Griffes (SEAW).*

Committee Mission Statement:

- *Improve communications between the public jurisdictions that administer building codes and the engineering design community that prepares construction documents.*
- *Improve consistency and quality of engineering submittals and project reviews.*
- *Build consensus between the engineering design community and building officials with regard to code interpretation and submittal requirements.*

I. INTRODUCTION:

The requirements for snow loading are specified in the International Building Code (IBC) and the accompanying ASCE 7, "Minimum Design Loads for Buildings and Other Structures" which has a table with Ground Snow Loads for Selected Locations in Washington. The SEAW "Snow Load Analysis for Washington," second edition 1995 (SEAW Analysis), provides ground snow loads for additional locations in Washington as well as a method for determining ground snow loads in locations not listed in ASCE 7 or Appendix A of the SEAW Analysis.

The SEAW Analysis is based on data from the National Weather Service and the Soil Conservation Service and provides methods to determine basic ground snow load throughout the state. It has been used successfully by design professionals including building officials for many years. The first edition was published in 1975.

This white paper is intended to coordinate the various codes and standards and to be a guideline for establishing a uniform approach to determining minimum ground snow loads, p_g, and roof snow loads, p_f, snow drift considerations in low-lying areas and other roof design considerations.

II. RECOMMENDATIONS/GUIDELINES:

For all areas in the State of Washington the procedures in the SEAW "Snow Load Analysis for Washington", 1995, 2nd edition or the ASCE 7, should be used to determine the minimum ground snow loads, p_g.

The roof snow loads should then be determined in accordance with ASCE 7 using the ground snow loads, p_g , as determined from the SEAW Analysis or ASCE 7 with exceptions for low-lying areas of Western Washington as discussed below.

In the SEAW Analysis the recommended ground snow loads are typically based on the values in Appendix A, or if in locations not provided for in Appendix A or ASCE 7, using the "mapped isoline values method". Areas with a significant discrepancy between the Appendix A values and the mapped isoline values warrant further investigation. The required ground snow loads should be verified with the local building official.

Low-Lying areas of Western Washington:

Recommendations for low-lying areas of Western Washington were presented in the WABO-SEAW August 2000 white paper, "Snow Load Regulations and Engineering Practices – Washington State". For the purposes of these recommendations, low-lying areas are defined in jurisdictions that have a recommended ground snow load of 25 psf or less in Appendix A of the SEAW 1995 "Snow Load Analysis for Washington". Some jurisdictions define "low-lying areas" as those at elevations less than 500' or 700'. Designers should check with the local building officials on the extent of low-lying areas for that jurisdiction.

Recommendations are:

1. In low-lying areas of Western Washington, it is recommended that all roof structures be designed for a minimum uniform roof snow load of 25 psf. However, this does not preclude certain jurisdictions from adopting a more conservative loading if historical data supports such, due to localized weather phenomenon or particular geographical features.

2. In low-lying areas of Western Washington, there is not a significant enough concern about drift to warrant proactive regulatory enforcement by the local jurisdiction. In some unusual cases (such as buildings with an [IBC] Importance Factor greater than 1), it may be appropriate for the design engineer to consider the effects of drift and the possibility of snow sliding off steep, upper roofs onto lower ones. However, the method for considering drift [ASCE 7] requires significant judgment which should generally fall within the realm of the design engineer, rather than become part of proactive jurisdiction enforcement.

3. To account for the potential of rain on snow effects in low-lying area, consideration should be given by the design engineer to adding an additional uniform load for low slope roofs.
4. It is recommended that those jurisdictions that do not have a specific written ordinance on snow loads adopt one.

General Recommendations:

The following general recommendations are for use by engineers and building officials. These include the recommendations presented in the "Study of Structural Failures Associated with the Winter 2008-2009 Snow Event in the Spokane/Coeur d'Alene Area," which was published in December 2009, as well as additional recommendations based on the experience of this committee. This is not an exhaustive list of recommendations but is presented here as a general guideline based on design experience of this committee and the performance of buildings in recent events.

Most of these recommendations are based on code requirements. We are not including the code references since those references often become obsolete with new editions of the code.

The snow loads currently determined from the SEAW Analysis are appropriate. Recommendations with regard to specific building types and vulnerabilities exposed in previous events are:

1. **Plate Connector Wood Structures.** Plate connector wood trusses are an efficient and common component of roof structures in contemporary construction. They are typically designed by the truss supplier for prescribed roof snow loads. Bracing of these framing systems must also be properly designed and installed. To achieve the design performance required, manufacturing, delivery, installation, and inspection must follow the current IBC and the current Truss Plate Institute recommendations.

2. **Heavy Timber Truss Construction.** The structural design community is aware of the poor historical performance of this type of structure and its potential for sudden collapse. Recent codes have also recognized that unbalanced snow loads can cause stress reversals in web members and have provided design provisions to address this issue. Properly renovated and strengthened, heavy timber trusses can provide safe and stable continued use.

3. **Wood Beam and Joist Framing Systems.** The committee recommends that care is taken by the design professional to account for any low-slope areas where ponding could occur.

4. **Steel Framed Structures.** Of steel framed structures, pre-engineered buildings were the most problematic. Current methods of design, manufacturing, permitting, installation, and inspection should be reviewed. Inadequate bracing resulted in a number of the failures observed during the snow event. Better communication between all parties would result in a better performing structure.

5. **Secondary Structures.** Many of the failed wood-framed secondary structures observed were likely not designed. Of these structures, most were garages or outbuildings, and most were more than 20 years old. For structures of this nature, not required to be designed by a design

professional, proper inspection is paramount to ensure that good construction practices are being incorporated.

6. Metal framed carports with long cantilevered roof decks did not perform well. Proper design, considering unbalanced loads will reduce the number of future failures.

7. **Flat or Low-Slope Roofs.** For new buildings, designers should give serious consideration to increasing roof slopes to 3/8" per foot or more to avoid ponding.

8. It is imperative in a low-slope roof to keep roof drains cleared and unobstructed. Unfortunately, this is often overlooked by building owners and the buildup of ice, snow or debris around a drain can prevent the roof from draining properly.

9. Some of the failures observed were due to additions or changes in roof geometry resulting in additional loads due to drifting and sliding snow. Proper evaluation of affected existing structures could reduce the number of structures that perform unsatisfactorily.

10. Any repair to a damaged member must be designed to meet the requirements of the current building code. It should be noted that in a well-designed system, a localized failure should not cause immediate or progressive collapse of the entire structure.

11. In high snow load areas, there can be a significant risk of falling snow or ice from the roof. Factors affecting this design include roof pitch, roofing "slipperiness", roof insulation over heated areas and unheated overhangs, applied heat, mechanical barriers to sliding snow, and reduced access to areas with hazard from falling snow or ice.

12. Drag forces due to sliding snow on roofing components in high snow load areas can be significant and should be considered.

13. Seismic loads due to snow should be included for roof snow loads over 30 psf in accordance with ASCE 7.

III. COMMENTARY:

In the aftermath of the Holiday Snow Storm (late December '96 – early January '97) and in an effort to establish a consistent design criteria which would benefit designers, building officials and builders, recommendations were formulated by an ad hoc committee made up of WABO and SEAW members in January 1999. This committee produced a WABO- SEAW white paper in 1999. The primary recommendations in that white paper were relative to low-lying areas of Western Washington. These recommendations were to use a minimum uniform roof snow load, p_f, of 25 psf and not require design for drifting snow.

In the winter of 2008-2009 in the Spokane/Coeur d'Alene area there was a significant snow event that led to structural failures. The SEAW Spokane Chapter produced a "Study of Structural Failures Associated with the Winter 2008-2009 Snow Event in the Spokane/Coeur d'Alene Area" which is also referred to here. This study generally confirms that the snow loads currently used in design for that area are appropriate but adds various recommendations with regard to specific building types and vulnerabilities exposed in that event.

The Ad-Hoc Committee of the Spokane Chapter of SEAW recommends retaining minimum design roof snow loads currently adopted by the jurisdictions in the Spokane and Coeur d'Alene area. The committee encourages improved communication among design professionals, building officials, and contractors to ensure that the built structure conforms to the design intent. It is the duty of the design professional to correctly implement the code design provisions for the building type and location. For structures constructed without design professional involvement, this responsibility rests with the owner and designer, but the permit-issuing government agency is responsible for verifying the design substantially conforms to the code.

References:

The above recommendations were developed by WABO/SEAW using the following reference documents:

IBC "International Building Code", Current Edition.

ASCE 7 "Minimum Design Loads for Buildings and Other Structures", Current Edition.

"Supplemental Design Examples for the Snow Load Analysis for Washington (Using SEI/ASCE 7-02 criteria)", 2nd Edition 2005.

WABO-SEAW White Paper "Snow Load Regulations and Engineering Practices, Washington State", January 1999.

"An Analysis of Building Structural Failures Due to the Holiday Storms", SEAW/FEMA, June 1998.

"Snow Load Analysis for Washington", 2nd Edition 1995, prepared by the Structural Engineers Association of Washington.

"Snow Loads: A Guide to the Snow Load Provisions of ASCE 7-05", Michael O'Rourke, Ph.D., P.E. Copyright © 2007 by the American Society of Civil Engineers. All Rights Reserved.

"Study of Structural Failures Associated with the Winter 2008-2009 Snow Event in the Spokane/Coeur d'Alene Area, December 2009.

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