

**HAZUS Building Attribute Rulesets - Wind - CERBL-M-H**

**Note: Defaults should be assigned to all CERBL-M-H Buildings as defined below; then rulesets should be applied to override those defaults as informed by available data.**

RoofCvr			Roof Cover
Valid Entries	N/A, BUR, SPM	Input Variable	YearBuiltNJDEP, RoofShape
Default	N/A	Input Variable Source	Custom Inventory
Years Ruleset Applies	Ruleset	Notes	Possible Extensions
YearBuiltNJDEP >= 1975	IF RoofShape = (Gable OR Hip), RoofCvr = N/A IF RoofShape = Flat, RoofCvr = SPM	<p>NJ Building Code Section 1507 (in particular 1507.10 and 1507.12) address Built Up Roofs and Single Ply Membranes. However, the NJ Building Code only addresses installation and material standards of different roof covers, but not in what circumstance each must be used.</p> <p>SPMs started being used in the 1960s, but different types continued to be developed through the 1980s. Today, single ply membrane roofing is the most popular flat roof option. BURs have been used for over 100 years, and although they are still used today, they are used less than SPMs. Since there is no available ruleset to be taken from the NJ Building Code, the ruleset is based off this information.</p> <p>Sources:  <a href="https://www.spri.org/2019/01/singe-ply-roofing-101/">https://www.spri.org/2019/01/singe-ply-roofing-101/</a>, <a href="https://continuingeducation.bnppmedia.com/courses/johns-manville/understanding-single-ply-roofing-systems/">https://continuingeducation.bnppmedia.com/courses/johns-manville/understanding-single-ply-roofing-systems/</a></p> <p>Assumptions of the Ruleset:  All flat roofs built before 1975 are BURs.  SPMs were developed in the 1960s, and considering that there is a time lag to start consistently using new methods, SPMs rose in importance through the 1970s, becoming more popular. This ruleset assumes that all roofs built after 1975 are SPMs.</p>	Any data from NJ on practices around BUR, SPM should be incorporated; trends presently inferred from when a technology entered the market
YearBuiltNJDEP < 1975	IF RoofShape = (Gable OR Hip), RoofCvr = N/A IF RoofShape = Flat, RoofCvr = BUR	<p>NJ Building Code Section 1507 (in particular 1507.10 and 1507.12) address Built Up Roofs and Single Ply Membranes. However, the NJ Building Code only addresses installation and material standards of different roof covers, but not in what circumstance each must be used.</p> <p>SPMs started being used in the 1960s, but different types continued to be developed through the 1980s. Today, single ply membrane roofing is the most popular flat roof option. BURs have been used for over 100 years, and although they are still used today, they are used less than SPMs. Since there is no available ruleset to be taken from the NJ Building Code, the ruleset is based off this information.</p> <p>Sources:  <a href="https://www.spri.org/2019/01/singe-ply-roofing-101/">https://www.spri.org/2019/01/singe-ply-roofing-101/</a>, <a href="https://continuingeducation.bnppmedia.com/courses/johns-manville/understanding-single-ply-roofing-systems/">https://continuingeducation.bnppmedia.com/courses/johns-manville/understanding-single-ply-roofing-systems/</a></p> <p>Assumptions of the Ruleset:  All flat roofs built before 1975 are BURs.  SPMs were developed in the 1960s, and considering that there is a time lag to start consistently using new methods, SPMs rose in importance through the 1970s, becoming more popular. This ruleset assumes that all roofs built after 1975 are SPMs.</p>	Any data from NJ on practices around BUR, SPM should be incorporated; trends presently inferred from when a technology entered the market
shutters			
Valid Entries	yes, no	Input Variable	YearBuiltNJDEP, WBD
Default	no	Input Variable Source	Custom Inventory
Years Ruleset Applies	Ruleset	Notes	Possible Extensions

YearBuiltNJDEP > 2000	IF WBD = yes, shutters = yes IF WBD = no, shutters = no	<p>1609.1.2 in 2015 IBC: Protection of Openings. In wind-borne debris regions, glazing in buildings shall be impact resistant or protected with an impact-resistant covering meeting the requirements of an approved impact-resistant covering meeting the requirements of an approved impact-resistant standard. Exceptions: Wood structural panels with a minimum thickness of 7/16 of an inch and a maximum panel span of 8 feet shall be permitted for opening protection in buildings with a mean roof height of 33 feet or less that are classified as a Group R-3 or R-4 occupancy.</p> <p>1609.1.2 Protection of Openings in the 2006 NJ IBC. In wind-borne debris regions, glazing in buildings shall be impact resistant or protected with an impact-resistant covering meeting the requirements of an approved impact-resistant covering meeting the requirements of an approved impact-resistant standard. Exceptions: Wood structural panels with a minimum thickness of 7/16 of an inch and a maximum panel span of 8 feet shall be permitted for opening protection in buildings with a mean roof height of 33 feet or less that are classified as a Group R-3 or R-4 occupancy.</p> <p>1609.1.4 Protection of Openings in the 2000 NJ IBC. In wind-borne debris regions, glazing in the lower 60 feet in buildings is required to be impact-resistant or meet standards of the Large and Small Missile Test. Exceptions: Wood structural panels with a minimum thickness of 7/16 of an inch and a maximum panel span of 8 feet shall be permitted for opening protection in one or two story buildings.</p>	
YearBuiltNJDEP ≤ 2000	IF WBD = yes, assign as Random Variable (RV): shutters = yes (RV = 45%) shutters = no (RV = 55%)	<p>Based on Human Subjects Data, roughly 45% of houses built in the 1980s and 1990s had entries that implied they had shutters on at some or all of their windows. Therefore, 45% of houses in this time should be randomly assigned to have shutters, and 55% should not.</p> <p>Data ranges checked: 1992 to 1995, 33/74 entries (44.59%) with shutters 1986 to 1992, 36/79 entries (45.57%) with shutters 1983 to 1986, 19/44 entries (43.18%) with shutters</p> <p>Valid Entries: 1 - Homemade storm panels (plywood) 4 - Shutters 5 - Store-bought storm panels 6 - Store-bought fabrics/screens 7 - Some other covering</p>	Further refine if more specific data is available

WindDebris			<i>wind Debris sources</i>
<b>Valid Entries</b>	Res/Comm, Varies by Direction, Residential, None	<b>Input Variable</b>	YearBuiltNJDEP, OccupancyClass
<b>Default</b>	Res/Comm	<b>Input Variable Source</b>	
<b>Years Ruleset Applies</b>	<b>Ruleset</b>	<b>Notes</b>	<b>Possible Extensions</b>
YearBuiltNJDEP ≤ Current Year	<p>If OccupancyClass = RES1, RES2, RES3A, RES3B, RES3C, RES3D, WindDebris=Residential</p> <p>If OccupancyClass = RES3E, RES3F, RES4, RES5, RES6, COM1, COM2, COM3, COM4, COM5, COM6, COM7, COM8, COM9, COM10, IND1, IND2, IND3, IND4, IND5, IND6, REL1, GOV1, GOV2, EDU1, EDU2, WindDebris=Res/Comm</p> <p>If OccupancyClass = AGR1, WindDebris=None</p>	If a building is a given class, according to zoning, neighboring buildings are likely of this class. Thus this assignment is made based on OccupancyClass. We cannot assign "varies by direction" because we don't have specific information.	More accurate assignments can be achieved by parsing zoning for each municipality.

WWR			<i>Window Wall Ratios</i>
<b>Valid Entries</b>	low, medium, high	<b>Input Variable</b>	YearBuiltNJDEP, WindowArea
<b>Default</b>	low	<b>Input Variable Source</b>	Custom Inventory
<b>Years Ruleset Applies</b>	<b>Ruleset</b>	<b>Notes</b>	<b>Possible Extensions</b>

YearBuiltNJDEP ≤ Current Year	<p>IF <math>0.2 \leq \text{WindowArea} &lt; 0.33</math>, WWR = Low  IF <math>0.33 \leq \text{WindowArea} &lt; 0.5</math>, WWR = Medium  IF <math>0.5 \leq \text{WindowArea}</math>, WWR = High</p>	<p>HAZUS defines these categories on window to wall ratios (WWR) as follows:  Low: <math>20\% \leq \text{WWR} &lt; 33\%</math>  Medium: <math>33\% \leq \text{WWR} &lt; 50\%</math>  High: <math>\text{WWR} \geq 50\%</math></p> <p>If WindowArea information available in Custom Inventory from street view data, this should be used to determine the Window Area being low, medium, or high. If this information is not available, all engineered residential buildings are assumed to have low window area. This ruleset was created from the information on the Reference Buildings from the Office of Energy Efficiency and Renewable Energy. Baltimore, MD was used as the test city because the climate was the most similar to Atlantic City of the data available. Office buildings (used as a test case for commercial), have 33% WWR and apartments (used as a test case for residential) have 15% WWR. Therefore, commercial is assumed to have medium window area, whereas residential buildings are assumed to have low window area.</p> <p>Source: <a href="https://www.energy.gov/eere/downloads/reference-buildings-building-type-midrise-apartment">https://www.energy.gov/eere/downloads/reference-buildings-building-type-midrise-apartment</a></p>	
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