HAZUS Building Attribute Rulesets - Wind - MECBL-M-H			
Note: Defaults should be assigned to all MECBL-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	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. 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. Sources: https://www.spri.org/2019/01/singe-ply-roofing-101/, https://continuingeducation.bnpmedia.com/courses/johns-manville/understanding-single-ply-roofing-systems/ 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.	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	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. 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. Sources: https://www.spri.org/2019/01/singe-ply-roofing-101/, https://continuingeducation.bnpmedia.com/courses/johns-manville/understanding-single-ply-roofing-systems/ 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.	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	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. 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. 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.	
YearBuiltNJDEP ≤ 2000	IF WBD = yes, Assign as Random Variable (RV): shutters = yes (RV = 46%) shutters = no (RV = 54%)	Shutters were not required by code until the 2000 IBC. Before 2000, the percentage of commercial buildings that have shutters is assumed to be 46%. This value is based on a study on preparedness of small businesses for hurricane disasters, which says that in Sarasota County, 46% of business owners had taken action to wind-proof or flood-proof their facilities. In addition to that, 46% of business owners reported boarding up their businesses before Hurricane Katrina. In addition, compliance rates based on the Homeowners Survey data hover between 43 and 50 percent. Source: https://www.sciencedirect.com/science/article/pii/S2212420916303855	Further refine if more specific data is available
WindDebris			
Valid Entries	Res/Comm, Varies by Direction, Residential, None	**Input Variable**	YearBuiltNJDEP, OccupancyClass

Default	Res/Comm	**Input Variable Source**	
Years Ruleset Applies	**Ruleset**	**Notes**	**Possible Extensions**
YearBuiltNJDEP ≤ Current Year	If OccupancyClass = RES1, RES2, RES3A, RES3B, RES3C, RES3D, WindDebris=Residential 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 If OccupancyClass = AGR1, WindDebris=None	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.

Metal-RDA			*Metal Roof Deck Attachment*
Valid Entries	standard, superior	**Input Variable**	YearBuiltNJDEP, DSWII
Default	standard	**Input Variable Source**	Custom Inventory
Years Ruleset Applies	**Ruleset**	**Notes**	**Possible Extensions**
YearBuiltNJDEP > 2000	IF DSWII ≤ 142 mph, Metal-RDA = standard IF DSWII > 142 mph, Metal-RDA = superior	Present to 2006: 1507.2.8.1 High Wind Attachment. Underlayment applied in areas subject to high winds (Vasd greater than 110 mph as determined in accordance with Section 1609.3.1) shall be applied with corrosion-resistant fasteners in accordance with the manufacturer's instructions. Fasteners are to be applied along the overlap not more than 36 inches on center. Underlayment installed where Vasd, in accordance with section 1609.3.1 equals or exceeds 120 mph shall be attached in a grid pattern of 12 inches between side laps with a 6-inch spacing at the side laps. 1507.2.8.1 High Wind Attachment. Underlayment applied in areas subject to high winds (Vasd greater than 110 mph as determined in accordance with Section 1609.3.1) shall be applied with corrosion-resistant fasteners in accordance with the manufacturer's instructions. Fasteners are to be applied along the overlap not more than 36 inches on center. Underlayment installed where Vasd, in accordance with section 1609.3.1 equals or exceeds 120 mph shall be attached in a grid pattern of 12 inches between side laps with a 6-inch spacing at the side laps. 1507.2.8.1 High Wind Attachment. Underlayment applied in areas subject to high winds (Vasd greater than 110 mph as determined in accordance with Section 1609.3.1) shall be applied with corrosion-resistant fasteners in accordance with the manufacturer's instructions. Fasteners are to be applied along the overlap not more than 36 inches on center.Underlayment installed where Vasd, in accordance with section 1609.3.1 equals or exceeds 120 mph shall be attached in a grid pattern of 12 inches between side laps with a 6-inch spacing at the side laps. 2000-2006: 1507.2.8.1 High Wind Attachment. Underlayment applied in areas subject to high winds (greater than 110 mph) shall be applied with corrosion-resistant fasteners in accordance with the manufacturer's instructions. Fasteners are to be applied along the overlap not more than 36 inches on center. According to Figure 1609, this is basic wind speed. convert Vasd to Vult using Vasd=sqrt(0.6)Vult --- 110 -> 142	
YearBuiltNJDEP ≤ 2000	Metal-RDA = standard	There is no mention of straps or enhanced tie-downs of any kind in the BOCA codes, and there is no description of these adoptions in IBHS reports or the New Jersey Construction Code Communicator. Although there is no explicit information, it seems that hurricane straps really only came into effect in Florida after Hurricane Andrew (1992), and likely it took several years for these changes to happen. Because Florida is the leader in adopting hurricane protection measures into codes and because there is no mention of shutters or straps in the BOCA codes, it is assumed that New Jersey did not adopt these standards until the 2000 IBC. https://www.insurancejournal.com/news/southeast/2007/05/18/79827.htm https://forum.nachi.org/t/hurricane-straps/4617 http://www.floridaretrofits.com/service/hurricaneStrapsClips Thus, all connections before 2000 are assumed to be standard.	

WWR			*Window Wall Ratio*
Valid Entries	low, medium, high	**Input Variable**	YearBuiltNJDEP, WindowArea
Default	medium	**Input Variable Source**	Custom Inventory
Years Ruleset Applies	**Ruleset**	**Notes**	**Possible Extensions**
YearBuiltNJDEP ≤ Current Year	IF 0.2 ≤ WindowArea < 0.33, WWR = Low IF 0.33 ≤ WindowArea < 0.5, WWR = Medium IF 0.5 ≤ WindowArea, WWR = High	HAZUS defines these categories on window to wall ratios (WWR) as follows: Low: 20% ≤ WWR < 33% Medium: 33% ≤ WWR < 50% High: WWR ≥ 50% If WindowArea informaiton avaible 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 residental 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. Source: https://www.energy.gov/eere/downloads/reference-buildings-building-type-midrise-apartment	