

HAZUS Building Attribute Rulesets - Wind - WSF1-2

Note: Defaults should be assigned to all WSF1-2 Buildings as defined below; then rulesets should be applied to override those defaults as informed by available data.

SWR			<i>Secondary Water Resistance</i>
Valid Entries	yes, no	Input Variable	RoofShape, YearBuiltNJDEP, RoofSlope, AvgJanTemp
Default	no	Input Variable Source	Custom Inventory
Years Ruleset Applies	Ruleset	Notes	Possible Extensions
YearBuiltNJDEP > 2000	Assign as a Random Variable (RV) IF RoofShape = Gable OR Hip, SWR = yes (RV = 60%) IF RoofShape = Gable OR Hip, SWR = no (RV = 40%)	Minimum drainage recommendations are in place in NJ (See below). However, SWR indicates a code-plus practice. Use homeowner compliance data from NC Coastal Homeowner Survey (2017) to capture potential human behavior (% of sealed roofs in NC dataset). Minimum Code Requirements: R903.4 Roof Drainage. Unless roofs are sloped to drain over roof edges, roof drains shall be installed at each low point of the roof: R903.4.1 Secondary (Emergency Overflow) Drains or Scuppers: Where roof drains are required, secondary emergency overflow roof drains or scuppers shall be provided where the roof perimeter construction extends above the roof in such a manner that water will be entrapped if the primary drains allow buildup for any reason.	Further refine percentage of sealed roofs as function of other core variates like home age, value, etc.
1983 < YearBuiltNJDEP ≤ 2000	IF RoofShape=Flat, SWR=yes ELSEIF RoofShape=(Gable or Hip) & RoofSlope ≤ 0.17, SWR=yes ELSEIF RoofShape=(Gable or Hip) & RoofSlope (> 0.17 & < 0.33) & AvgJanTemp=Below, SWR=yes ELSEIF RoofShape=(Gable or Hip) & RoofSlope (> 0.17 & < 0.33) & AvgJanTemp=Above, SWR=no ELSEIF RoofShape=(Gable or Hip) & RoofSlope ≥ 0.33, SWR=no	This rule applies until 1984, for anything from 1983 or earlier, there is no information available so this rule will continue to be applied. According to 903.2 in the 1995 CABO, for roofs with slopes between 2:12 and 4:12, an underlayment consisting of two layers of No. 15 felt must be applied. In severe climates (less than or equal to 25 degrees average in January), these two layers must be cemented together. According to 903.3 in the 1995 CABO, roofs with slopes greater than or equal to 4:12 shall have an underlayment of not less than one ply of No. 15 felt. Two layers of felt cemented together is considered to be secondary water resistance. This ruleset is for asphalt shingles. Almost all other roof types require underlayment of some sort, but the ruleset is based on asphalt shingles because it is most conservative. According to table No. R-803.4 in 1992 CABO, for roofs with slopes between 2:12 and 4:12 in severe climates (less than or equal to 25 degrees average in January), one layer no 40 coated roofing or coated glass base sheet from the eaves to 12 inches inside the exterior wall line is required. The rule used for asphalt shingles is assumed to apply to every roof because more specific requirements based on roofing type were not specified. According to R-803.3 in the 1989 CABO, for roofs with slopes between 2:12 and 4:12, an underlayment consisting of two layers of No. 15 felt must be applied. In severe climates (less than or equal to 25 degrees average in January), these two layers must be cemented together. According to R803.2 in the 1989 CABO, roofs with slopes greater than or equal to 4:12 shall have an underlayment of not less than one ply of No. 15 felt. Two layers of felt cemented together is considered to be secondary water resistance. This ruleset is for asphalt shingles. Almost all other roof types require underlayment of some sort, but the ruleset is based on asphalt shingles because it is most conservative. According to R-803.3 in 1986 CABO, for roofs with slopes between 2:12 and 4:12 in severe climates (less than or equal to 25 degrees average in January), one layer no 40 coated roofing or coated glass base sheet from the eaves to 12 inches inside the exterior wall line is required. The rule used for asphalt shingles is assumed to apply to every roof because more specific requirements based on roofing type were not specified. According to R-803.1 and R-803.2 in 1983 CABO, for roofs with slopes between 2:12 and 4:12 in severe climates (less than or equal to 25 degrees average in January), two layers of Type 15 felt must be applied and cemented together from the eaves up the roof to overlie a point twenty four inches inside the interior of the building.	
RDA-wood			<i>Roof Deck Attachment</i>
Valid Entries	A, B, C, D	Input Variable	YearBuiltNJDEP, DSWII
Default	A	Input Variable Source	Custom Inventory
Years Ruleset Applies	Ruleset	Notes	Possible Extensions
YearBuiltNJDEP > 2000	IF DSWII > 130, RDA-wood = D IF DSWII ≤ 130, RDA-wood = B	Post 2016: Adjustment in wind speed from basic wind speed to ultimate wind speed: NJ code requires 8d nails (with spacing 6"/12") for sheathing thicknesses between ¾"-1" - see Table R602.3(1). Fastener selection is contingent on thickness of sheathing in building codes. Commentary for Table R602.3(1) indicates 8d nails with 6"/6" spacing (enhanced roof spacing) for ultimate wind speeds greater than 130 mph. Pre-2015:IRC 2000-2009 (effective from 2002-2011 as per Model Code Adoptions document) requires 8d nails (with spacing 6"/12") for sheathing thicknesses between ¾"-1", see Table R602.3(1). Commentary for Table R602.3(1) indicates 8d nails with 6"/6" spacing (enhanced roof spacing) for basic wind speeds greater than 100 mph. NJ code requires 8d nails (with spacing 6"/12") for sheathing thicknesses between 5/16"-1/2" according to Table R602.3(1). Fastener selection is contingent on thickness of sheathing in building codes. Commentary (footnote g) for Table R602.3(1) indicates that enhanced roof spacing is required for basic wind speeds greater than 100 mph.	

YearBuiltNJDEP ≤ 2000	Assign as Random Variable (RV): RDA-wood = A (RV=50%) RDA-wood = B (RV=50%)	<p>Based on Table No. 602.3a of the 1995 CABO code, these nailing specifications are required for roof and wall sheathing to framing. Typical rafter spacings would require 0.625" thickness sheathing; thinner sheathing would be possible, though recommended at 7/16 in hurricane zones based on FORTIFIED standards. With no way to determine actual sheathing thickness, assign as a random variable.</p> <p>original logic: "IF SheathingThick (=> 0.3125 & <=0.5), RDA-wood = A IF SheathingThick (=>0.59375 & <=1.125), RDA-wood = B"</p> <p>1992: Table No. R-402.3a specifies the use of 8d nails, but does not seem to have any further information on spacing or placement. Thus, this ruleset assumes that the specifications for the roof deck attachment in this year are the same as those specified in the 1995, 1989, and 1983 CABO building codes.</p> <p>Based on Table No. R-402.3a of the 1989 CABO code, these nailing specifications are required for roof and wall sheathing to framing. Typical rafter spacings would require 0.625" thickness sheathing; thinner sheathing would be possible, though recommended at 7/16 in hurricane zones based on FORTIFIED standards. With no way to determine actual sheathing thickness, assign as a random variable.</p> <p>Original Logic IF SheathingThick (=> 0.3125 & <=0.5), RDA-wood = A IF SheathingThick (=>0.59375 & <=1), RDA-wood = B</p> <p>This rule is valid up to 1984. For 1983 and older, there was no information available so this rule is applied to all those vintages as well.</p> <p>Based on Table No. R-402.3.2 of the 1983 CABO code, these nailing specifications are required based on sheathing thickness. Typical rafter spacings would require 0.625" thickness sheathing; thinner sheathing would be possible, though recommended at 7/16 in hurricane zones based on FORTIFIED standards. With no way to determine actual sheathing thickness, assign as a random variable.</p> <p>Original Logic "IF SheathingThick (=> 0.3125 & <=0.5), RDA-wood = A IF SheathingThick (=>0.625 & <=1), RDA-wood = B"</p>	
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R2WC				Roof to Wall Connection
Valid Entries	strap, toe-nail	Input Variable		YearBuiltNJDEP, HPR, DSWII
Default	toe-nail	Input Variable Source		Custom Inventory
Years Ruleset Applies	Ruleset	Notes		Possible Extensions
2015 < YearBuiltNJDEP ≤ Present	IF HPR = no, R2WC = toe nail IF HPR = yes, R2WC = strap	<p>Assume all homes not having wind speed consideration are Toe Nail (regardless of year)</p> <p>For homes with wind speed consideration, 2015 IRC Section R802.11: no specific connection type, must resist uplift forces using various guidance documents, e.g., straps would be required (based on WFCM 2015); will assume that if classified as HPR, then enhanced connection would be used.</p>		
1992 < YearBuiltNJDEP ≤ 2015	IF DSWII > 142, R2WC = strap IF DSWII ≤ 142, R2WC = toe nail	<p>In Section R802.11.1 Uplift Resistance of the NJ 2009 IRC, roof assemblies which are subject to wind uplift pressures of 20 pounds per square foot or greater are required to have attachments that are capable of providing resistance, in this case assumed to be straps. Otherwise, the connection is assumed to be toe nail.</p> <p>In Section R802.11.1 Uplift Resistance of the NJ 2006 IRC, roof assemblies which are subject to wind uplift pressures of 20 pounds per square foot or greater are required to have attachments that are capable of providing resistance, in this case assumed to be straps. Otherwise, the connection is assumed to be toe nail.</p> <p>In Section R802.11.1 Uplift Resistance of the NJ 2000 IRC, roof assemblies which are subject to wind uplift pressures of 20 pounds per square foot or greater are required to have attachments that are capable of providing resistance, in this case assumed to be straps. Otherwise, the connection is assumed to be toe nail.</p> <p>802.11 Roof Tie-Down: Roof assemblies subject to wind uplift pressures of 20 lbs per sq ft or greater shall have rafter or truss ties. The resulting uplift forces from the rafter or truss ties shall be transmitted to the foundation.</p> <p>R-702.10 Roof Tie-Down: Roof assemblies subject to wind uplift pressures of 20 lbs per sq ft or greater shall be designed in accordance with accepted engineering practice, or rafter or truss ties shall be provided in accordance with Table No. R-702.10. This section of the 1992 CABO code specifies either design requirements of rafter/truss ties. The rule assumes that for all wind uplift pressures greater than or equal to 20 lbs per sq ft has straps.</p> <p>Roof uplift pressure varies by wind speed, exposure category, building aspect ratio and roof height. For a reference building (9 ft tall in exposure B -- WSF1) analysis suggests that wind speeds in excess of 110 mph begin to generate pressures of 20 psf in high pressure zones of the roof. Thus 110 mph is used as the critical velocity.</p> <p>This is assumed a nominal velocity and converted to Vult by $V_{asd} = \sqrt{0.6} V_{ult}$</p>		
YearBuiltNJDEP ≤ 1992	R2WC = toe nail	<p>There is no mention of straps or enhanced tie-downs in the CABO codes older than 1992, and there is no description of these adoptions in IBHS reports or the New Jersey Construction Code Communicator .</p> <p>Although there is no explicit information, it seems that hurricane straps really only came into effect in Florida after Hurricane Andrew (1992). Because Florida is the leader in adopting hurricane protection measures into codes and because there is no mention of shutters or straps in the CABO codes, it is assumed that all roof-wall connections for residential buildings are toe nails before 1992.</p> <p>https://www.insurancejournal.com/news/southeast/2007/05/18/79827.htm https://forum.nachi.org/hurricane-straps/4617 http://www.floridaretrofits.com/service/hurricaneStrapsClips</p>		

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>R301.2.1.2 in NJ IRC 2015 says protection of openings required for buildings located in WBD regions, mentions impact-rated protection for glazing, impact-resistance for garage door glazed openings, and finally states that wood structural panels with a thickness > 7/16" and a span <8' can be used, as long as they are precut, attached to the framing surrounding the opening, and the attachments are resistant to corrosion and are able to resist component and cladding loads;</p> <p>R301.2.1.2 in NJ IRC 2009 says protection of openings required for buildings located in WBD regions, mentions impact-rated protection for glazing, impact-resistance for garage door glazed openings, and finally states that wood structural panels with a thickness > 7/16" and a span <8' can be used, as long as they are precut, attached to the framing surrounding the opening, and the attachments are resistant to corrosion and are able to resist component and cladding loads.</p> <p>R301.2.1.2 in NJ IRC 2006 says protection of openings required for buildings located in WBD regions, mentions impact-rated protection for glazing, impact-resistance for garage door glazed openings, and finally states that wood structural panels with a thickness > 7/16" and a span <8' can be used, as long as they are precut, attached to the framing surrounding the opening, and the attachments are resistant to corrosion and are able to resist component and cladding loads.</p> <p>R301.2.1.2 in NJ IRC 2000 says protection of openings required for buildings located in WBD regions, mentions impact-rated protection for glazing, impact-resistance for garage door glazed openings, and finally states that wood structural panels with a thickness > 7/16" and a span <8' can be used, as long as they are precut, attached to the framing surrounding the opening, and the attachments are resistant to corrosion and are able to resist component and cladding loads.</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 by house

Agarage		Attached Garage	
Valid Entries	none, SFBC 1994, standard, weak	Input Variable	YearBuiltNJDEP, Garage, Shutters
Default	standard	Input Variable Source	Custom Inventory
Years Ruleset Applies	Ruleset	Notes	Definitions
YearBuiltNJDEP > 2000	IF shutters = yes & Garage<1, Agarage = none IF shutters = yes & Garage>=1, Agarage = SFBC 1994 IF shutters = no & Garage < 1, Agarage = none IF shutters = no & Garage >=1, Agarage = standard	For garage doors in WBD regions, glazed opening protection is required and must meet the requirements of an approved impact-resisting standard or ANSI/DASMA 115. Only "none," "weak," or "standard" are given options for unshuttered houses, so this information is not included in the ruleset. Average lifespan of a garage is 30 years, so garages that are not in WBD (and therefore do not have any strength requirements) that are older than 30 years are considered to be weak, whereas those from the last 30 years are considered to be standard.	shuttered houses = garage II (SFBC 1994, none) unshuttered house = garage I (none, weak, standard)
(Current Year - 30) < YearBuiltNJDEP ≤ 2000	IF Garage<1, Agarage = none IF Garage>=1, Agarage = standard	For garage doors in WBD regions, glazed opening protection is required and must meet the requirements of an approved impact-resisting standard or ANSI/DASMA 115. Only "none," "weak," or "standard" are given options for unshuttered houses, so this information is not included in the ruleset. Average lifespan of a garage is 30 years, so garages that are not in WBD (and therefore do not have any strength requirements) that are older than 30 years are considered to be weak, whereas those from the last 30 years are considered to be standard.	shuttered houses = garage II (SFBC 1994, none) unshuttered house = garage I (none, weak, standard)
YearBuiltNJDEP ≤ (Current Year - 30)	IF Garage<1, Agarage = none IF Garage>=1, Agarage = weak	There is nothing about what defines a weak or standard garage in the CABO code. Average lifespan of a garage is 30 years, so garages that are older than 30 years are considered to be weak, whereas those from the last 30 years are considered to be standard. If there is any further information about garage replacements for homeowners, this can be added to the ruleset later.	Further refine if more information on household garage replacements, etc