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Walls, gross area, includes 1' rim for 2-story, SF	2070	2808
Window area, SF	360	360
Roof type (gable or hip)	Hip	Hip
Roof slope	7:12	7:

Assuming new construction on a developed lot as illustrated in Figure 1, the areas of fuel modification for the reference houses are shown in Table 6.

Single story	11250	3,275		195	
2 story	11250	1,791		285	

Automatic Sprinkler Systems

IWUIC 2018 requires an approved automatic sprinkler system be installed in all occupancies in new buildings meeting the requirements for IR 1 construction. California is not impacted by this cost because an automatic sprinkler system is mandated for residential buildings by the local code.

Building Components

Characteristics of a house that make it vulnerable to wildland-urban interface fires include exterior features like roof covering, exterior siding, door and window trim, the presence of an exterior deck, and the presence of trees, vegetation or other landscaping on the surrounding lot.

IWUIC 2018 requirements for IR 1 construction mandate specific practices for various exterior components of the building. Building components of the reference houses analyzed for this study include soffit and fascia, vents, downspouts and gutters, exterior wall cladding, exterior windows and exterior doors.

Cost of an automatic sprinkler, exterior deck and defensible space are provided as separate costs in Table 7 and 8 to differentiate the cost of the basic house components from the cost of additional features. The cost estimate does not include landscape maintenance costs.

RESULTS

Summary of Cost Impact of IWUIC Code Compliance

Tables 5 and 6 summarize the estimated cumulative impact of constructing the reference houses to the 2018 IWUIC. The cost is adjusted for selected city's location factor in each state.

Roof covering	$0	$0	$0	$0	$0	$0
Soffit and Fascia						

Reference Code Section

2018 IWUIC Section 504.3 Protection of Eaves.

Summary of the Code:

IR1 construction requires soffits to be protected on the exposed underside by ignition-resistant materials or by materials approved for not less than 1-hour fire-resistance-rated construction, 2-inch nominal dimension lumber, or 1-inch nominal fire-retardan

Reference Code Section

2018 IWUIC Section 504.4 Gutters and Downspouts

Summary of the Code:

IR 1 construction requires gutters and downspouts to be constructed of noncombustible material. It also requires gutters be provided with an approved means to prevent accumulation of leaves and debris in the gutter.

Cost Implication of the Code Compliance:

Compliance with this code section will increase the cost of construction for the given reference houses due to replacing vinyl gutters and downspouts with aluminum gutters and downspouts and providing gutter guards to cover the gutters. The costs are applicable to all three locations.

Reference Code Section

2018 IWUIC Section 504.6 Underfloor enclosure

Summary of

Reference Code Section

2018 IWUIC Section 504.10 Vents

Summary of the Code:

IR 1 construction requires attic ventilation openings, foundation or underfloor vents, or other ventilation openings in vertical exterior walls and vents through roofs to not exceed 144 square inches each. It also requires such vents to be covered with noncombustible corrosion-resistant mesh with openings not to exceed ¼ inch or be designed and approved to prevent flame or ember penetration into the structure. Further, vents are not permitted in the soffit areas.

Reference Code Section

2018 IWUIC Section 504.8 Detached accessory structures

Summary of the Code:

IR 1 construction requires detached accessory structures located less than 50 feet from a building containing habitable space to have exterior walls constructed with materials approved for not less than 1-hour fire-resistance-rated construction, heavy timber, log wall construction, or constructed with approved noncombustible materials or fire-retardant-treated wood on the exterior side.

Cost Implication of the Code Compliance:

Compliance with this code section does not have any cost impact as the lots for the reference houses do not have any detached structures within 50 feet of habitable space.

Reference Code Section

2018 IWUIC Section

Reference Code Section

2018 IWUIC Section 602 Automatic sprinkler system

Summary of the Code:

IR 1 construction requires approved automatic sprinkler system to be installed in all occupancies in new buildings.

Cost Implication of the Code Compliance:

Compliance with this code section will increase the cost of construction where automatic fire sprinkler systems are not already mandated by the local code. The Home Fire Sprinkler Cost Assessment- 2013[11] report by The Fire Protection Research Foundation showed that the maximum cost for residential sprinkler system was $2.47 ($/sprinkled SF) because of the additional cost associated with different piping materials and permitting and fees for sprinkler system. This rate is used to calculate the high cost impact for the reference houses using a sprinkled area of 2600 SF.

APPENDIX D: FIRE HAZARD SEVERITY

	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate	High
	Moderate	Moderate	High	High	High	High	Extreme	Extreme	Extreme
	High	High	High	High	Extreme	Extreme	Extreme	Extreme	Extreme

IWUIC 2018 defines light fuel as vegetation consisting of herbaceous plants and round wood less than ¼ inch (6.4 mm) in diameter. Fuel models A, C, E, L, N, P, R and S described in IWUIC Appendix D are classified as light fuel. Medium fuel comprises vegetation consisting of round wood ¼ to 3 inches (6.4 mm to 76 mm) in diameter. Fuel models B, D, F, H, O, Q and T are classified under this category. Similarly, heavy fuel comprises vegetation consisting of round wood 3 to 8 inches (76 mm to 203 mm) in diameter. Fuel models G, I, J, K and U are classified as heavy fuel. Table D2 lists the various fuel models provided in Appendix D of IWUIC 2018.

"*Vegetation consisting of herbaceous plants and round wood less than 1/4 inch (6.4 mm) in dia.*"	
"*Vegetation consisting of round wood 1/4 to 3 inches (6.4 mm to 76 mm) in diameter.*"	
"*Vegetation consisting of round wood 3 to 8 inches (76 to 203 mm) in diameter.*"	

Table D3 provides elaborate description of various fuel models and is an excerpt from National Fire Danger Rating System, 1978, U.S. Department of Agricultural Forest Service, General Technical Report INT-39[12] that has been provided for information in Appendix D of 2018 IWUIC.

[12] https://www.fs.fed.us/rm/pubs_int/int_gtr169.pdf

Fuel Model A	*"This fuel model represents western grasslands vegetated by annual grasses and forbs. Brush or trees may be present but are very sparse, occupying less than a third of the area. Examples of types where Fuel Model A should be used are cheatgrass and medusahead. Open pinyon-juniper, sagebrush-grass, and desert shrub associations may appropriately be assigned this fuel model if the woody plats meet the density criteria. The quantity and continuity of the ground fuels vary greatly with rainfall from year to year."*
Fuel Model B	*"Mature, dense fields of brush 6 feet (1829 mm) or more in height are represented by this fuel model. One-fourth or more of the aerial fuel in such stands is dead. Foliage burns readily. Model B fuels are potentially very dangerous, fostering intense, fast-spreading fires. This model is for California mixed chaparral generally 30 years or older. The F model is more appropriate for pure chamise stands. The B model may also be used*

Fuel Model G	*"Fuel Model G is used for dense conifer where there is a heavy accumulation of litter and downed woody material. Such stands are typically overmature and may also be suffering insect, disease, wind or ice damage-natural events that create a very heavy buildup of dead material or the forest floor. The duff and litter are deep, and much of the woody material is more than 3 inches (76 mm) in diameter. The*

Fuel Model O	*"The O fuel model applies to dense, brushlike fuels of Southeast. O fuels, except for a deep litter layer are almose entirely living in contrast to B fuels. The foliage burns readily, except during the active growing season. The plants are typically over 6 feet (1829 mm) tall and are often found under an open stand of pine. The high pocosins of Virginia, North and South Carolina coasts are the ideal of Fuel Model O. If the plants do not meet the 6-foot (1829 mm) criterion in those areas, Fuel Model D should be used."*
Fuel Model P	*"Closed, thrifty stands of long-needled southern pines are characteristic of P fuels. A 2- inch to 4-inch (51 to 102 mm) layer of lightly compacted needle litter is the primary fuel. Some small-diameter branchwood is present, but the density of the canopy precludes more than a scattering of shrubs and grass. Fuel Model P has the high moisture of extinction characteristic of the Southeast. The corresponding model for other long-needled pines is U."*
Fuel Model Q	*"Upland Alaskan black spruce is represented by Fuel Model Q. The stands are dense but have frequent openings filled with usually flammable shrub species*

Fuel Model U	*"Closed stands of western long-needled pines are covered by this model. The ground fuels are primarily litter and small branchwood. Grass and shrubs are precluded by the dense canopy but occur in the occasional natural opening. Fuel Model U should be used for Ponderosa, Jeffrey, sugar pine, and red pine stans of the Lake States. Fuel model P is corresponding model for southern pine plantations."*

The table below covers the locations where each type of reference house foundation would be pragmatically constructed. All these selected cities, except Chicago, lie within the top ten states for construction starts in 2013.[15] Chicago was selected to represent a Climate Zone 5 house.

Foundation		Slab	Slab	Basement	Basement
Miami	1	X	X		
Los Angeles	3	X	X		X*
Dallas	3	X	X		X*
Seattle	4	X	X	X	X
New York	4	X	X	X	X
Chicago	5			X	X
Fairbanks	8			X	X

[15] www.census.gov/construction/bps/pdf/2013statepiechart.pdf