 doi:10.20944/preprints201901.0256.v1

Report

Defensible Spaces and Home Ignition Zones of Wildland-Urban Interfaces in the Fire-prone Areas of the World†

Shahriar Rahman [1,*] and Sanzida Rahman [2]

[1] Department of Environmental Sciences, Macquarie University; rahman.shahriar@mail.com
[2] Department of Urban & Regional Planning, Khulna University of Engineering & Technology (KUET); sanzidarahman.bd15@gmail.com
* Correspondence: rahman.shahriar@mail.com; Tel.: +61-469746677.
† Research report from the upcoming Wildland-Urban Interface and Fire Risk Assessment and Mitigation Project (research proposal development): 10 November 2018.

Abstract: Wildland-Urban Interfaces are in high risk of wildfires. Defensible spaces and home ignition zones are the two main aspects to protect lives and livelihoods of W-UI in the United States, Canada and Australia. Different part of the world has different rules and regulations for W-UI land management. We have discussed the defensible spaces in fire-prone areas, and current ignition zone distances with the fire resistance plant species to save lives and assets in the prominent fire-prone zones (United States, Canada and Australia) of the world.

Keywords: Defensible Space; Fire Resistance; Ignition Zone; Wildfire; Wildland.

1. Introduction

Wildland-Urban Interface (W-UI) is the area where houses meet or intermingle with undeveloped wildland vegetation [1]. The W-UI is thus a focal area for human environment conflicts, such as the destruction of homes by wildfires, habitat fragmentation, introduction of exotic species, and biodiversity decline [1]. W-UI land is in great demand for new houses and other developments because people enjoy visiting and living in natural settings [2]. Not only for hiking, biking, and picnicking, but rather to live, in primary residences and second homes [3]. This inspiring beauty, however, masks a wide range of potential threats, of which many homeowners are unaware. The W-UI is widespread in the United States and in many other parts of the world, including Canada, Argentina, Greece, Australia, France, and South Africa [4-6]. Residential lots built in the W-UI are much more likely to take up more space than homes built in the non-W-UI. This is an important characteristic of the W-UI because low-density housing is more costly to protect. In other words, what matters when calculating the costs of protecting homes from wildfires is not just the number of homes, but the per acre use of land per home. Residential lots near wildlands also take up more than twice the space of homes built in other places. On average across the West, housing near forested land covers 2.3 acres per residence compared to 1.1 acres per residence on other western private lands. This is important because sprawled housing costs more to protect from wildfire [7].

The close proximity of houses and wildland vegetation does more than increase fire risk. As houses are built in the W-UI, native vegetation is lost and fragmented landscaping introduces non-native species and soils are disturbed, causing non-natives to spread; pets kill large quantities of wildlife; and zoonotic disease, such as Lyme disease, are transmitted. Thus, understanding W-UI patterns and W-UI growth is important with respect to wildfires and many other environmental

problems [4]. For resource managers, the W-UI is an important place because the presence of people and structures in or near the wildlands impacts both the resources they manage, and the social pressures they face in managing them. For residents, the outcomes of fire in the W-UI are negative and unequivocal. If they are lucky, only smoke, evacuation, and disruption of ordinary life will result; homeowners who are not so lucky may lose their home and everything in it. The W-UI is a difficult and potentially dangerous setting in which to fight fires because fire fighters are typically trained to fight either structural or wildland fires, but rarely both [8]. Climate change, building practices, and land management are increasing wildfire risks [2,9,10]. The W-UI will become increasingly important as more homes are built in W-UI areas and as fire activity increases due to climate change. Understanding forest fires in the W-UI is crucially important due to potential impacts on land management, economics, ecological relationships, and human communities [11].

Depending on the area of the country, fire departments might refer to wildland fires as bush fires, forest fires, rangeland fires, or something else; however, they are all part of the W-UI and all pose the same threat to local assets [12]. Wildfires can be caused by nature, such as lava or lightning, but most are caused by humans. Human-caused fires result from campfires left unattended, the burning of debris, negligently discarded cigarettes, and intentional acts of arson. Lightning is one of the two natural causes of fires. There are two types of lightning: cold lightning and hot lightning. Cold lightning is a return stroke with intense electrical current but of relatively short duration. Hot lightning has currents with less voltage, but these occur for a longer period of time. Fires are usually started by unusually long-lasting hot lightning bolts [13]. The W-UI has received considerable attention because of recent increases in both the number of structures destroyed and the area burned annually by wildland fire [14]. Communities adjacent to and surrounded by wildland are at varying degrees of risk from wildfires. The effects of wildland fire on communities have become more intense, frequent, and far-reaching. Increased development in the W-UI means higher wildfire risk and more suppression needs, costing billions every year. A comprehensive approach to preparedness and mitigation is an effective way to address increasing suppression costs and reduce risk to communities [15].

2. Defensible Space

A defensible space is an area around a building in which vegetation, debris, and other types of combustible fuels have been treated, cleared, or reduced to slow the spread of fire to and from the building [16]. Two zones make up the required 100 feet of defensible space. The two zones are: the home defense zone; and the reduced fuel zone [17].

2.1. Zone 1 # within 30 feet of the home [16,18]:

- Eliminate all combustible materials such as fire-prone vegetation, firewood stacks, combustible patio furniture, umbrellas, and dimensioned lumber decking. Remove all dead plants, grass and weeds (vegetation), dead or dry leaves and pine needles from yard, roof and rain gutters
- Before fire season begins, remove combustible litter on roofs and gutters and trim tree branches (minimum of 10 feet from other trees) that overhang the roof and chimney (10 feet away)
- Remove or prune flammable plants and shrubs near windows
- Remove vegetation and items that could catch fire from around and under decks.

Preprints (www.preprints.org) | NOT PEER-REVIEWED | Posted: 25 January 2019 doi:10.20944/preprints201901.0256.v1

2.2. Zone 2 # 100 feet out from buildings, structures and decks [18]:

- Use hardscape features such as driveways and paved or gravel walkways or patios to create firebreaks throughout the yard
- Plant fire-resistant, low-volume vegetation that retains moisture well and needs minimum maintenance such as pruning and removing dead and dying branches
- Separate auxiliary structures such as a detached garage, pump house, pergola, and utility shed from the home by at least 50 feet. Increase the distance if the structure is used for the storage of combustible materials
- Comply with recommended construction practices related to fire resistance for auxiliary structures
- Ensure that patio furniture is either made of non-combustible material such as metal or is at least 30 feet away from the building. Store patio furniture in a location that is protected from ignition by a wildfire
- Place woodpiles at least 30 feet from the building and store the wood in a vegetation free zone such as a graveled area
- Store fuel tanks away from a structure at the minimum distance that is required by code or greater and place underground or on a non-combustible pad
- Cut or mow annual grass down to a maximum height of 4 inches
- Create horizontal spacing between shrubs and trees. Horizontal spacing depends on the slope of the land and the height of the shrubs or trees. For flat to mild slope (less than 20%) it's 10 feet., for mild to moderate slope (20%-40%) it's 20 feet, and for moderate to steep slope (>40%) it's 30 feet
- Create vertical spacing between grass, shrubs and trees (Remove all tree branches at least 6 feet from the ground
- Remove fallen leaves, needles, twigs, bark, cones, and small branches. However, they may be permitted to a depth of 3 inches.

2.3. Zone 3:

Reduce fuels that are farther than 100 feet from the building by thinning and pruning vegetation horizontally and vertically as discussed above. Thinning and pruning in Zone 3 can be more limited than in Zone 2. The goals in Zone 3 are to improve the health of the wild lands and help slow an approaching wildfire. Zone 3 is also an aesthetic transition between the more heavily modified Zone 2 and the unmodified surroundings [16].

3. Home Ignition Zone

3.1. United States:

The Home Ignition Zone (HIZ) is that circular area of 30-100 feet area around a house. Zone 1 represents the first 30-foot area around a house. Zone 2 represents the 30 to 60-foot area. Zone 3 encompasses the 60 to100-foot area around the house. Reducing ignitable and performing preventive maintenance in these zones are excellent ways to reduce risk of damage or loss due to wildfires. Begin with a complete walk around your house and look for vulnerabilities [19].

Roof and eaves:

- Roofing materials should repel fires, such as, Class A fire-retardant shingles, metal, or tiles of clay or concrete. No missing shingles; no gaps; and litter-free peaks, valleys, and gutters.
- Eaves should be closed. Soffits should be made of flame retardant materials or well painted (ply) wood. Vents should be metal. Decorative attic vents should be lined with fine mesh metal screening to repel embers
- If wood occurs in #2 above, maintain the condition of the wood surfaces with paint or paint-like products to prevent exposed wood grain which can harbour embers and ignite hours later

 doi:10.20944/preprints201901.0256.v1

- Gutters should be kept clean of leaves. The way our homes are constructed in River Place, leaf filled gutters are one of the most vulnerable areas to our homes from wildfires.

Outer walls:

- Brick, stone, stucco or combined masonry materials are considered flame-retardant. Decorative wood-like insets should be flame retardant. If real wood grain is exposed to weathering, maintain with paint, varnish, stain, etc. to reduce exposed wood grain where embers can nestle
- Dual pane windows resist heat breakage but can overheat and break, allowing flame entry. Flammable materials should be kept away from windows so as not to break the windows and bring the fire inside
- Nooks and crannies should be free of litter and bird nests. Embers can ignite leaves and litter and generate enough heat to ignite a wooden front door.

Trees, shrubs, and lawns:

- Remove tree limbs that overhang roof and/or eaves. When these trees drop leaves, they will fill the gutters that they overhang. Also remove those smaller branches that approach eaves
- Cut lowest tree limbs 6-10 feet from ground so climbing flames cannot ignite trees
- Keep shrubs under trees pruned low so they cannot ignite tree limbs
- Keep shrubs pruned 10-12 feet away from structural walls of the house
- Keep shrubs in front of windows pruned 2-3 feet below windows
- Keep climbing vines away from house, windows, entry arches, porch swings, etc.
- Keep vines away from wooden fences or trellises
- Keep vegetation well-watered so that stems and trunks stay moist
- Keep grass lawns trimmed and watered
- Keep driveway clear of flammables so as to serve as a firebreak

Wooden Decks:

- If it's attached to the house, it's a part of the house
- Keep wooden decks well maintained with paint or stain finish so that wood grain is not exposed. When replacing decks, consider using materials that are fire resistant
- Remove self-starting artificial logs at least 30-feet away from the house or deck
- Remove litter from under deck; replace with sand or pebbles
- Store flammables (propane) at least 30 feet away from the house or deck
- Keep hoses attached to bibs front and back to save seconds if fire should occur
- Keep wooden trellises maintained with desired finish
- Remove cushions from deck furniture when gone long periods of time
- Store door mats in garage when gone over long periods of time

Wooden fences:

- Maintain with desired finish to cover exposed wood grain and to slow weathering
- Keep vines away from climbing onto wooden fences
- Trim grasses to prevent contact with wooden fence slats
- Trim vegetation away from inner and outer side of wood fencing
- Consider replacing wood fencing with metal. As a minimum if the wood fence touches the home use metal flashing to isolate the fence from the home. A better solution is to use a metal fence to connect privacy fences along the property line to the home.

Other considerations:

Preprints (www.preprints.org) | NOT PEER-REVIEWED | Posted: 25 January 2019 doi:10.20944/preprints201901.0256.v1

- Crown Separation: Cut touching tree crowns so that flames do not spread at treetops. Try to obtain 3-5 feet between trees
- Trim branches that hang over your property line to reduce spread of fire
- Honor the size limitations of cuttings so that vegetation is hauled away on service days
- Do not discard cuttings into adjacent wild lands

"Dead and down" trees tossed into wild land slopes ignite as easily as fireplace logs. Wind speeds increase with the angle of a slope, putting hilltop property at greater risk. If you enter adjacent land that is on a restricted nature preserve, you could be fined or, in worst case, your house could be destroyed by those "dead and down" flaming logs while you are away. Choose Fire-Resistant Plants and Materials [18]:

- Create fire-safe zones with stone walls, patios, decks and roadways
- Use rock, mulch, flower beds and gardens as ground cover for bare spaces and as effective firebreaks
- There are no "fire-proof" plants. Select high-moisture plants that grow close to the ground and have a low sap or resin content
- Choose fire-retardant plant species that resist ignition such as rockrose, ice plant and aloe
- Select fire-resistant shrubs such as hedging roses, bush honeysuckles, currant, cotoneaster, sumac and shrub apples
- Plant hardwood, maple, poplar and cherry trees those are less flammable than pine, fir and other conifers

Fire resistant plants are great in California because they are often drought tolerant too.

- French Lavender: It is a fire resistant plant that thrives in dry growing conditions
- Red Monkey Flower: It yields beautiful bright red blossoms and it is also drought tolerant
- California Fuchsia: These perennial flowers are fire safe and needs little to no water once established
- Sage: This plants provide fire resistance while being drought tolerant
- California Lilac: These colorful shrubs are fire resistant as well as drought tolerant
- Society Garlic: These plants are fire safe and grow in drought prone regions
- Ornamental Strawberry: These ground cover plants are fire resistant and are used to give lush
- Yellow Ice Plant: These are very low-growing groundcover with succulent, green foliage. This succulent requires very little watering and fire safe
- Coreopsis: These plants are fire safe
- California Red Bud: These colorful shrubs are fire resistant and drought tolerant too.

3.2. Australia:

The home ignition zone accounts for flammable items on the lot and around the house. It includes such items as the trees, shrubs, ornamental beds, grass, out buildings, decks, fences, and fire woods items that can burn and/or carry a fire [20]. The home ignition zone also includes the structure itself, particularly construction materials such as wood shingles and siding, open soffits, vinyl soffits, and attached wood decks and fences [21]. Construction material plays a particularly important role with respect to types of ignition. There are three ways a home can ignite: firebrands or embers, direct flame contact, and radiant heat. Firebrands are floating embers generated by burning vegetation or

 doi:10.20944/preprints201901.0256.v1

structures that can land on flammable items and ignite them [20]. It is observed that just a single 50-mm ember can ignite a dry cedar shingle and determined that airflow and the trapping of firebrands in small crevices played a critical role in ignition. Based on ignition tests, the critical fuel-bed angle for ignition is between 90 and 135° [22]. Similarly, radiant heat can ignite, melt, or damage materials (e.g., vinyl soffits, siding, and windows), which may expose other flammable materials to possible ignition [21]. For instance, a burning shrub, outside a vinyl window with single-pane glass, may cause the window to break or melt, thereby enabling embers to enter the house increasing the probability of an ignition. To minimize likelihood of home ignition, a homeowner must eliminate the potential for ignition and interrupt the path of a wild land fire as it approaches his/her home [20].

Researcher suggests a minimum distance of 9.1 m (30 ft.) from natural vegetation on level surfaces and possibly greater than 30.5 m (100 ft.) for house slopes [23]. Aesthetically, it is not necessary to remove all vegetation from residential lots [20]. Ornamental beds should be separated by areas that will not burn (e.g., managed grass); plants should be pruned regularly and dead material removed to reduce fire ladders; plants themselves should be isolated and not overlapping, and beds and plants should be at least 1.5 m (5 ft.) from any structure or flammable materials (Long and Randall 2004). Selection of plant material for an ornamental bed should be based on a plant's flammability characteristic [24]. For instance, plants with low flammability could be placed in beds 1.5 m from the house, whereas plants with high-flammability characteristics would be placed in beds at greater distances from the house (e.g., 9.1 m) [20]. In other words, a homeowner can create an aesthetically pleasing landscape yard but must be aware that it takes only one weak point for ignition to occur during a wild land fire [21]. It is reported that more than 50% of the structures were ignited within 3 h after the main fire front hit the community; 67% of the homes were ignited directly or indirectly by embers; 40% of the structures destroyed were on the perimeter, as compared to 25% in the interior of the community; and defensive actions were effective in reducing losses from more than 37% to 30% [25].

Plants that are fire-resistant have the following characteristics [26]:

- Leaves are moist and supple
- Plants have little dead wood and tend not to accumulate dry, dead material within the plant
- Sap is water-like and does not have a strong odour
- Sap or resin materials are low.

Most deciduous trees and shrubs are fire-resistant [26].

Suggested plants [26]:

Groundcovers:

Scientific Name	Common Name	Description
Ajuga reptans	Carpet bugleweed	Groundcover grown mostly for its bronze, purple, variegated, and dark green foliage. Flower spikes rise above the foliage in early summer.
Aubrieta deltoidea	Rock cress	Mat-forming, spreading perennial with grayish-green foliage. Attractive masses of flowers in spring.
Antennaria rosea	Pink pussytoes	An attractive groundcover with silvery gray foliage and tiny flowers. Can be used between paving stones and in rock gardens.

Preprints (www.preprints.org) | NOT PEER-REVIEWED | Posted: 25 January 2019 doi:10.20944/preprints201901.0256.v1

Perennials:

Scientific Name	Common Name	Description
Achillea species	Yarrow	Fernlike foliage in shades of green to gray. Long-blooming and very drought tolerant. Make nice cut or dried flowers. Can be invasive.
Allium schoenoprasum	Chives	A popular culinary herb with grass like foliage and showy pink or purple flowers. Cut flowers back when done blooming
Armeria maritima	Sea thrift	Clump-forming perennial with grass like foliage. Flowers rise above the mound with pink or white pom-pom flowers.

Shrubs-broadleaf evergreen:

Scientific Name	Common Name	Description
Ceanothus gloriosus	Point Reyes ceanothus	Small, wide-spreading shrub with dark green, leathery foliage and blue-purple flowers in spring. Useful on steep coastal banks. Needs protection from wind. Short-lived plant (5–10 years). Varieties available.
Cotoneaster apiculatus	Cranberry cotoneaster	A broadleaf semi-evergreen. Dark, shiny, green leaves, changing to burgundy in the fall. Interesting mounding growth habit. Produces tiny, pink flowers followed by a red cranberry like fruit that persists into winter. Eastern exposure is best.
Cistus purpureus	Orchid rockrose	An evergreen with a compact growth habit, green-gray leaves, and showy, reddish-purple flowers. Tolerates wind and salt spray.

Shrubs—deciduous:

Scientific Name	Common Name	Description
Acer circinatum	Vine maple	A Pacific Northwest native with an upright growth habit and attractive red, orange, to yellow fall color.
Amelanchier species	Serviceberry	A multi-stemmed shrub or tree that bears white flowers in spring followed by edible, purplish-black fruit. Excellent fall colors of red-orange. Prefers additional moisture.
Acer glabrum	Rocky Mountain maple	Small tree or large shrub with attractive dark green foliage and red twigs. The “helicopter” seeds turn reddish in summer. Attractive red fall color.

Trees—conifer:

Scientific Name	Common Name	Description
Larix occidentalis	Western larch	An attractive, deciduous conifer with a pyramidal growth habit and soft, green needles that turns yellow in fall.

 doi:10.20944/preprints201901.0256.v1

Scientific Name	Common Name	Description
Pinus ponderosa	Ponderosa pine	Beautiful pine tree with long, green needles in groups of two or three. Growth habit becomes more open with age. Interesting bark texture and cinnamon-brown bark color.
Acer ginnala	Amur maple	Small tree or large shrub with irregular growth habit and excellent red fall color. Good choice for a small area can be used to create a hedge. A subspecies of Tatarian maple

3.3. Canada:

Home with its immediate surroundings (about 100-150 feet from the structure) is called the Home Ignition Zone [27]. The Fire Smart program identifies 3 priority zones that must be managed to reduce the wildfire threat to your home. Priority Zones 1 (10 m) and 2 (30 m) are the most critical– this is known as the Home Ignition Zone (HIZ). The actual building design and construction material used to construct your home, the type of plant material and the design of the landscape immediately adjacent to your home is a critical factor in determining the likelihood of your home surviving a wildfire. It is important to select fire resistant plant material and design your landscape to reduce the risk, while maintaining a functional and water smart landscape appropriate to your growing zone [28]. The HIZ is divided into three zones [19]:

- Immediate Zone [19]:

The home and the area 0-5' from the furthest attached exterior point of the home; defined as a non-combustible area. Science tells us this is the most important zone to take immediate action on as it is the most vulnerable to embers.

1. Clean roofs and gutters of dead leaves, debris and pine needles that could catch embers
2. Replace or repair any loose or missing shingles or roof tiles to prevent ember penetration
3. Reduce embers that could pass through vents in the eaves by installing 1/8 inch metal mesh screening
4. Clean debris from exterior attic vents and install 1/8 inch metal mesh screening to reduce embers
5. Repair or replace damaged or loose window screens and any broken windows Screen or box-in areas below patios and decks with wire mesh to prevent debris and combustible materials from accumulating
6. Move any flammable material away from wall exteriors – mulch, flammable plants, leaves and needles, firewood piles – anything that can burn.
7. Remove anything stored underneath decks or porches.

- Intermediate Zone [19]:

5-30' from the furthest exterior point of the home:

1. Clear vegetation from under large stationary propane tanks
2. Create fuel breaks with driveways, walkways/paths, patios, and decks
3. Keep lawns and native grasses mowed to a height of four inches

Preprints (www.preprints.org) | NOT PEER-REVIEWED | Posted: 25 January 2019 doi:10.20944/preprints201901.0256.v1

4. Remove ladder fuels (vegetation under trees) so a surface fire cannot reach the crowns. Prune trees up to six to ten feet from the ground; for shorter trees do not exceed 1/3 of the overall tree height
5. Space trees to have a minimum of eighteen feet between crowns with the distance increasing with the percentage of slope
6. Tree placement should be planned to ensure the mature canopy is no closer than ten feet to the edge of the structure (National Fire Protection Association 2018).
7. Tree and shrubs in this zone should be limited to small clusters of a few each to break up the continuity of the vegetation across the landscape

- Extended Zone [19]:

30-100 feet, out to 200 feet. Landscaping – the goal here is not to eliminate fire but to interrupt fire's path and keep flames smaller and on the ground.

1. Dispose of heavy accumulations of ground litter/debris
2. Remove dead plant and tree material
3. Remove small conifers growing between mature trees
4. Remove vegetation adjacent to storage sheds or other outbuildings within this area
5. Trees 30 to 60 feet from the home should have at least 12 feet between canopy tops
6. Trees 60 to 100 feet from the home should have at least 6 feet between the canopy tops.

Characteristics of fire-resistant plants [28]:

- Moist, supple leaves
- Little dead wood and tendency not to accumulate dead material
- Water-like sap with little or no odour
- Low amount of sap or resin material

When selecting plants for landscape, it is needed to ensure that the selected plants are appropriate to the area and hardiness zone.

Suggested trees:

Scientific Name	**Common name**
Acer ginnala	Amur Maple
Acer macrophyllum	Bigleaf Maple
Acer palmatum	Japanese Maple

Suggested Shrubs:

Scientific Name	**Common name**
Berberis sp.	Barberry
Buddleia sp.	Butterfly Bush
Caluna vulgaris	Heather

Suggested Vines and Groundcover:

Scientific Name	**Common name**
Ajuga reptans	Carpet Bugle
Antennaria rosea	Pussytoes
Arctostaphylos uva-ursi	Kinnickinnick

Suggested Grasses:

Scientific Name	Common name
Agropyron cristatum	Wheatgrass, Crested, Western
Bouteloua gracilis	Mosquito Grass, Blue Grama Grass
Buchloe dactyloides	Buffalo grass

Suggested Perennials and Biennials:

Scientific Name	Common name
Achillea sp.	Yarrow
Alcea rosea	Hollyhock
Anaphalis margaritacea	Pearly Everlasting

Suggested Annuals:

Scientific Name	Common name
Antirrhinum majus	Snapdragon
Gazania ringens	Gazania
Geranium sp.	Geranium

Suggested Bulbs:

Scientific Name	Common name
Allium cernum	Nodding Onion
Crocus sp.	Crocus
Lilium sp.	Lily

Building Materials:

- Stone, Masonry, and Concrete: Stone, masonry, and concrete are three building material groups which can resist fire effectively, especially wildfires, as they usually extinguish once the fuel for the fire is consumed. Design Recommendations [29]:
    1. Stone, Masonry and Concrete, alone or in combination, would be ideal for protecting the building envelope from the forces of a wildfire
    2. Stone, Masonry and Concrete, alone or in combination, would be ideal in the construction of a one storeyed building
- Structural Steel and Metals:

Steel will lose its load-carrying capacity in fire when it reaches its critical temperature (i.e. the temperature at which it cannot safely support its load). Usually steel is used to fabricate the structure of a building and would be located in the interior of the building. Aluminium is another material used in building construction to fabricate non-structural components, such as window frames. Aluminium has a very low melting point compared to steel, quickly losing any structural properties when exposed to heat, and would not withstand the forces of a wildfire. Use of an aluminium curtain wall is discouraged [29].

- Heavy Timber Construction:

As stated by the Canadian Wood Council, large dimension wood sections have an inherent resistance to fire. Wood burns slowly at approximately 0.6mm/minute. Where combustible materials cannot be avoided, heavy timber construction in conformance with sections 3.1.4.5 to 3.1.4.6 of the ABC could be considered to fabricate the structure of a building [29].

Author Contributions: Shahriar Rahman: Conceptualisation, manuscript preparation, editing and review; Sanzida Rahman: Literature review and writing: assisted Shahriar Rahmain in draft preparation.

Conflicts of Interest: The authors declare no conflict of interest.

References

1. Radeloff, V.C.; Hammer, R.B.; Stewart, S.I.; Fried, J.S.; Holcomb, S.S.; McKeefry, J.F. The wildland–urban interface in the United States. *Ecological applications* **2005**, *15*, 799-805.
2. Verisk. Wildland-urban interface risks are increasing. Availabe online: https://www.verisk.com/insurance/visualize/wildland-urban-interface-risks-are-increasing/ (accessed on 6 October).
3. USDA. A Look at Life in the Wildland Urban Interface. Availabe online: https://www.usda.gov/media/blog/2015/10/27/look-life-wildland-urban-interface (accessed on 6 October).
4. Radeloff, V.C.; Helmers, D.P.; Kramer, H.A.; Mockrin, M.H.; Alexandre, P.M.; Bar-Massada, A.; Butsic, V.; Hawbaker, T.J.; Martinuzzi, S.; Syphard, A.D. Rapid growth of the US wildland-urban interface raises wildfire risk. *Proceedings of the National Academy of Sciences* **2018**, *115*, 3314-3319.
5. Rahman, S.; Chang, H.C.; Magill, C.; Tomkins, K.; Hehir, W. Forest Fire Occurrence and Modeling in Southeastern Australia. In *Forest Fire*, InTech: 2018; p. 151.
6. Rahman, S. Determining the Impact of Fire Severity on Vegetation Regrowth As a Result of the Greek Forest Fires 2007. University of Southampton, 2014.
7. EPS. *A Profile of Development and the Wildland-Urban Interface (WUI)*; Economic Profile System (EPS), Headwaters Economics: Montana, USA, 2015.
8. Stewart, S.I.; Radeloff, V.C.; Hammer, R.B. Characteristics and location of the wildland-urban interface in the United States. In Proceedings of 2 nd International Wildland wildfire Ecology and wildfire Management Congress. Orlando, Florida.
9. Rahman, S.; Chang, H.-C.; Hehir, W.; Magilli, C.; Tomkins, K. Inter-Comparison of Fire Severity Indices from Moderate (Modis) and Moderate-To-High Spatial Resolution (Landsat 8 & Sentinel-2A) Satellite Sensors. In Proceedings of IGARSS 2018-2018 IEEE International Geoscience and Remote Sensing Symposium; pp. 2873-2876.
10. Rahman, S.; Chang, H.-C. Assessment of fire severity and vegetation response using moderate-resolution imaging spectroradiometer: Moderate resolution (MODIS) satellite images to assess vegetation response after a big fire event at the selected national parks around Sydney, Australia. In Proceedings of Sensing Technology (ICST), 2017 Eleventh International Conference on; pp. 1-6.
11. Johnston, L.M.; Flannigan, M.D. Mapping Canadian wildland fire interface areas. *International journal of wildland fire* **2018**, *27*, 1-14.
12. IAFC. The Ready, Set, Go! . Availabe online: http://www.wildlandfirersg.org/About/Wildland-Urban-Interface (accessed on 9 September).
13. USDI. Wildland Fire - Learning In Depth. Availabe online: https://www.nps.gov/articles/series.htm?id=ED398874-1DD8-B71B-0B594AA554EB0E8C (accessed on 2 October).
14. NIFC. Wildland Fire Statistics. Availabe online: https://www.nifc.gov (accessed on 2 October).
15. WUIMC. *Wildland Urban Interface Wildfire Mitigation Desk Reference Guide*; Wildland Urban Interface Mitigation Committee (WUIMC), The National Wildfire Coordinating Group: 2017.
16. FEMA. Home Builder's Guide to Construction in Wildfire Zones. (FEMA), F.E.M.A., Ed. 2008.

17. FireSafe. Defensible Space. Availabe online: https://www.firesafesanmateo.org/resources/defensible-space (accessed on 8 October).
18. CALFIRE. Prepare for Wildfire. Availabe online: http://www.readyforwildfire.org/Defensible-Space/ (accessed on 8 October).
19. NFPA. Home Ignition Zone. Availabe online: http://www.riverplacehoa.org/wp-content/uploads/HOME-IGNITION-ZONE.pdf (accessed on 6 October).
20. Mercer, D.E.; Zipperer, W. Fire in the wildland–urban interface. *Urban–rural interfaces: Linking people and nature* **2012**, 287-303.
21. Doran, J.D.; Randall, C.K.; Long, A.J. Fire in the wildland-urban interface: Selecting and maintaining firewise plants for landscaping. *Gainesville, FL: University of Florida, Institute of Food and Agricultural Sciences; USDA Forest Service, Southern Research Station, Southern Center for Wildland-Urban Interface Research and Information. 7 p.* **2004**.
22. Manzello, S.L.; Park, S.-H.; Cleary, T.G. Investigation on the ability of glowing firebrands deposited within crevices to ignite common building materials. *Fire Safety Journal* **2009**, *44*, 894-900.
23. Cohen, J.D. What is the wildland fire threat to homes? *Thompson Memorial Lecture, School of Forestry, Northern Arizona University, Flagstaff, AZ, 10 April 2000.* **2000**.
24. White, R.H.; Zipperer, W.C. Testing and classification of individual plants for fire behaviour: plant selection for the wildland–urban interface. *International Journal of Wildland Fire* **2010**, *19*, 213-227.
25. Mell, W.E.; Manzello, S.L.; Maranghides, A.; Butry, D.; Rehm, R.G. The wildland–urban interface fire problem–current approaches and research needs. *International Journal of Wildland Fire* **2010**, *19*, 238-251.
26. Detweiler, A.J.; Fitzgerald, S.A. Fire-resistant plants for home landscapes: Selecting plants that may reduce your risk from wildfire. **2006**.
27. Cohen, J.D.; Johnson, N.; Walther, L. *Saving homes from wildfires: regulating the Home Ignition Zone*; National Emergency Training Center: 2001.
28. FireSmart. *FireSmart Guide to Landscaping*; Government of Alberta, Canada: 2016.
29. AI. *Guideline for Wildfire Protection of Institutional Buildings in Forested Regions in Alberta*; Technical Services Branch, Alberta Infrastructure (AI): 2013.