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# A Guide to Wildfire Risk:

## Mitigating Exposure with Data and Design

# Summary



# Introduction

Wildfires have become an increasingly severe threat to buildings and communities across the United States. In 2024 alone, over 7.5 million acres were consumed by wildfires nationwide. The economic impact is equally staggering; for instance, the January 2025 wildfires in Los Angeles resulted in over $250 billion in economic losses and destroyed more than 16,200 structures. As climate change continues to escalate the frequency and intensity of these events, understanding and enhancing building performance during wildfires has become imperative.

The spread of wildfires is influenced by various factors, including topography, wind speed, and the presence of combustible materials. Fires can advance rapidly through multiple pathways such as direct flame contact, airborne embers, and radiant heat, leading to the ignition of structures through various mechanisms. Given the complexity of wildfire behavior, a uniform mitigation strategy is often insufficient.

This guide examines key factors influencing building vulnerability to wildfire, including defensible space, construction materials, roof systems, and fire protection measures. Additionally, it highlights how Archipelago's platform provides insights into various building attributes that contribute to fire resilience. By leveraging structured data and analytics, property owners, insurers, and risk managers can make more informed decisions to mitigate wildfire risks, improve building survivability, and ultimately reduce losses.

Archipelago's platform captures critical building data points, including construction type, roof systems, wall systems, and fire protection measures, allowing users to assess and mitigate wildfire risks effectively. By offering structured and enriched property data, Archipelago empowers risk managers, insurers, and property owners to make data-driven decisions and improve wildfire resilience strategies.

## About The Author

Dr. Erin Ashley is the Vice President of Risk Engineering at Archipelago, specializing in building performance following high-hazard events. Before joining Archipelago, she held a Climate Resilience Fellowship and served as the Federal Resilience Lead for a multinational architecture and engineering consulting firm. Her research primarily focuses on forensic engineering and the post-disaster assessment of building systems, particularly after wildfires.

Dr. Ashley has co-authored presidential executive orders related to climate resilience, as well as federal and state legislation, building codes, and federal resilience frameworks. She has also held multiple technical committee positions related to building and resilience standards, currently serving on The National Green Building Standard committee. She earned her Bachelor of Science degree in Fire Protection Engineering, along with a Master's and Ph.D. in Reliability Engineering from the University of Maryland.

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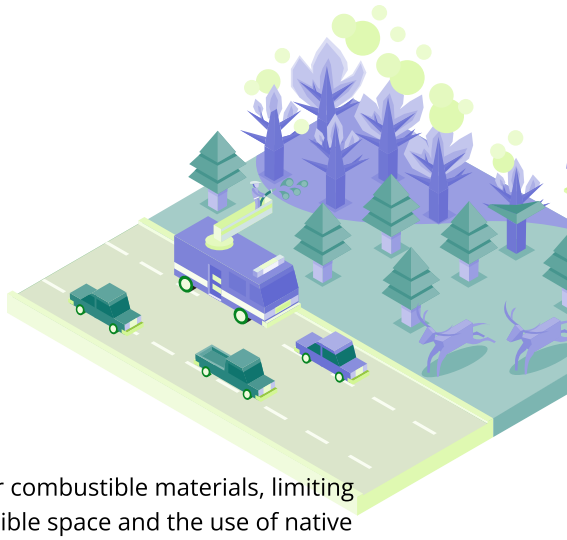
# Factors Influencing Wildfire Resilience



## Defensible Space

Defensible space creates a buffer between a structure and adjacent vegetation or combustible materials, limiting fire spread. Proper landscape management, including the maintenance of defensible space and the use of native and fire-resistant plants, is the most important factor in reducing a building's susceptibility to wildfire. A recommended minimum of 30 feet with up to 100 feet of defensible space can significantly mitigate risk.

Archipealgo captures defensible space between the structure and other combustibles. Additionally, Archipelago provides the "Distance to Nearest Building" attribute, which can help assess proximity risks from adjacent combustibles. For outside of a building, Archipelago has attributes detailing exterior fuel storage and whether a community participates in the FireWise Program.

Archipelago's data enables users to assess exposure from adjacent buildings, helping identify risks that could contribute to wildfire spread. This information supports a more comprehensive risk evaluation when coupled with traditional defensible space assessments.

## Construction Type

The materials and methods used in a building's construction impact its ability to withstand wildfire exposure. While wildfires primarily threaten structures from the exterior, certain construction types offer greater resistance to fire spread.

### Fire—resistant materials:

- Masonry
- Reinforced cast-in-place concrete
- Precast concrete
- Steel

### High—risk materials:

- Light wood
- Light metal
- Manufactured homes

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# Roof Systems

The roof is one of a building's most vulnerable components during a wildfire, as embers can ignite accumulated debris or enter through openings.

### Fire—resistant materials:

- Metal
- Concrete
- Slate
- Built-up roofing (BUR)
- Asphalt shingles with Class A ratings

### High—risk materials:

> Can accumulate debris and increase risk of ignition

- Roof systems with complex geometries
- Roofs with abrupt elevation changes
- Roofs with significant joint exposure

### Maintenance considerations:

As a roof ages, fire retardants may degrade, increasing ignition risk.

**Roofing Material:** Archipelago captures the fire rating for the roof covering. A Class A roof system is the highest fire resistance rating for roofing, offering the best protection against severe fire exposure. It's designed to withstand intense flames, heat, and radiant energy, preventing fire from spreading and penetrating the roof.

Soffits, often made of combustible materials like wood or vinyl, are vulnerable to wildfire due to vulnerability to ignition. Soffits may trap windborne embers posing a significant risk to a home's structure. Enclosing soffits with fire-resistant materials, like those with a 1-hour fire resistance rating, can help protect against wildfire damage. Archipelago captures soffit information for both combustibility of the soffit and resistance to wind loads.

Similar to soffits, the roof overhang is a vulnerable aspect of the roof system. A roof overhang, such as an open eave, can trap embers and increase the susceptibility to ignition. Archipelago captures information related to the roof overhang.

Roof vents are a particular vulnerability to wildfire as they can be an entry point for wind driven embers. To ensure the maximum level of fire resistance, fire resistant vents or vents covered with a mesh screen should be provided. Archipelago captures whether a roof vent is present and if said vent is protected with fine mesh screening.

While not directly related to fire resistance, adequate roofing material anchorage ensures that the roofing materials stay on the roof, covering the combustible portions of the roof deck, during a high wind event (which often occurs during a wildfire). Archipelago captures the Roofing Material Anchorage information and Bolts, Screws, Induction Welds, and some nails which perform better in high wind situations.

The roof material installation year does not correlate directly with performance during a fire event. However, as a roof system ages, any applied fire retardant may degrade. Additionally, as the roofing material ages, portions of the roof may become dislodged, increasing the risk of ignition. Archipelago captures the Roof Material Installation Year and the Roof Replacement Year.

The roof deck is part of the roof system. A noncombustible roof deck may reduce the chance of ignition of the roof system. Archipelago captures the Roof Deck Material and Steel Decking, Precast Concrete Panels, Concrete, and Heavy Steel tend to perform well. Again, it is imperative that the full roof system be designed to Class A standards.

Archipelago captures Roof Geometry. Specific complex roof shapes may capture debris or burning embers, increasing the propensity for ignition. Gable and hip roof shapes tend to perform well if properly maintained.

Roof drainage systems may impact ignition and fire spread as debris often accumulates in the drainage system. Gutters are often susceptible to high levels of debris. Archipelago captures Roof Drainage System information, and internal drains and scuppers tend to perform well.

Roof parapets, screens, and signs may also be features that capture debris and increase the chance of ignition. Archipelago captures Roof Parapets Anchorage/Bracing and Roof Screens/Signs Anchorage, and no roof parapets and no roof screens & signs pose the least risk.

# Wall Systems

Exterior walls can be ignited through direct flame exposure, radiant heat, and ember accumulation. Choosing fire-resistant wall coverings is crucial for reducing wildfire risk.

### Preferred materials:

- Concrete
- Masonry

### High—risk materials:

- Wood siding
- EIFS (Exterior Insulation and Finish Systems)
- Vinyl siding

Care should be taken to consider the windows and other elements of the building envelope before fully assessing the risk to the structure. Archipelago captures the type of wall cladding the fire rating for this cladding. Additionally, when the fire rating of the cladding is unknown, Archipelago maps the cladding to the associated fire rating classification, Class A, B or C.

# Windows and Doors

Windows and doors are potential weak points, as glass can break under radiant heat or flame exposure, leading to interior ignition.

### Best practices:

- Multi-pane tempered glass
- Fire-resistant frames
- Engineered shutters

### Glass type:

- Annealed
- Tempered
- Heat-strengthened
- Laminated
- IGU (Insulated Glass Units)

### Vulnerabilities:

- Single-pane windows
- Combustible doors with non-fire-rated glass

Archipelago captures Window and Frame Type, Glass Type, Glass Percentage, and Building Exterior Opening. While anecdotal, greater quantities of glass in a structure may indicate a greater susceptibility to window breakage and ignition of interior contents.

Archipelago provides information on whether the window has Window Glazing Protection. Engineered shutters, non-engineered shutters, and some laminated glazing systems perform well in wildfire events.

Archipelago provides data on the Door and Frame Type. While there is no fire resistance rating of a given door, Archipelago can determine if the doors are wood, glass or metal. Heavy wood doors and metal doors perform well during a fire event.

## Accessory and Adjacent Structures

Accessory structures, such as garages and outbuildings, can act as ladder fuels, transferring fire from the environment to the main structure.

Archipelago provides data on accessory structures and roof appendages, assisting in evaluating the potential for fire spread. The platform's ability to catalog secondary structures helps insurers and risk professionals gain a holistic view of wildfire risks.

Archipelago specifically documents properties with combustible and non-combustible decking and fencing materials as these often contribute to fire spread.

# Fire Protection Considerations

While interior fire sprinklers are essential for internal fire suppression, they provide limited protection against wildfires, which are primarily external threats. However, certain fire protection strategies can enhance resilience:

### Backup power systems:

Generators can maintain functionality for fire pumps and safety systems.

### Adequate water sources:

Hydrant flow rates and external sprinkler systems can help contain fire spread.

### Fire—resistant landscaping:

Strategic placement of non-combustible materials around the building reduces ignition potential.

Archipelago collects data on fire protection measures, including sprinkler systems, backup generators, and combustible material storage locations. These insights assist in evaluating whether a structure has the necessary fire suppression and prevention measures to mitigate wildfire risks effectively.

# Case Study: A Tale of Two Buildings

To illustrate the impact of wildfire resilience measures, consider two hypothetical commercial buildings located in a wildfire-prone region.

## **BUILDING A**: High—Risk Structure

*No defensible space; surrounded by dense vegetation.*

*Constructed with wood framing and combustible exterior siding.*

*Asphalt shingles with no Class A fire rating.*

*Single-pane windows without fire-resistant glazing.*

*No exterior fire protection measures.*

### Outcome:

In the event of a wildfire, Building A is highly susceptible to ignition. Embers can easily land on the roof and ignite debris, flames can rapidly spread through the combustible siding, and radiant heat can shatter windows, allowing fire to enter. The structure is at high risk of total loss.

## **BUILDING B**: Fire—Resilient Structure

*Maintains a 100-foot defensible space with fire-resistant landscaping.*

*Constructed with reinforced concrete and non-combustible exterior walls.*

*Equipped with a Class A-rated metal roofing system.*

*Features multi-pane tempered glass windows with fire-resistant frames.*

*Includes fire-resistant doors and exterior sprinkler systems.*

### Outcome:

Building B has significantly higher chances of survival in a wildfire. The defensible space prevents fire from reaching the structure, the non-combustible materials reduce ignition risk, and fire-resistant windows and doors prevent flames from penetrating the interior. Overall, Building B demonstrates enhanced resilience and lower insurability risks.

# Conclusion

Wildfires present an ongoing challenge, but proactive risk assessment and mitigation strategies can significantly reduce building vulnerability. By analyzing key attributes such as defensible space, construction materials, roofing systems, and fire protection measures, stakeholders can enhance resilience and minimize potential losses.

Archipelago's data-driven insights enable more accurate wildfire risk assessments, helping property owners and insurers make informed decisions to protect assets and communities. By offering detailed building data, Archipelago supports a more comprehensive understanding of property vulnerabilities, allowing for targeted mitigation strategies and improved resilience against wildfire threats. Through the use of structured data, organizations can improve preparedness and contribute to safer, more resilient built environments.

# What SOV data impacts wildfire resilience?

| Attribute | Impact on Wildfire Resistance |
|---|---|
| Address / Location | Location may increase or decrease wildfire susceptibility. |
| Year Built | Year built impacts wildfire resistance as newer building codes may require greater fire separation, fire resistance or other building features. Depending on year and location the building resides. |
| Number of Stories - Above Ground | While anecdotal, a greater number of stories increases the surface area susceptible to ignition. |
| Building Footprint Class | While limited, complex buildings such as U-shaped or T-shaped may increase the areas in which fire debris or vegetative debris can accumulate. |
| Distance to Nearest Building | Significant impact on susceptibility to wildfire. |
| Landslide Susceptibility | Wildfires increase the chance of landslides. |
| Site Soil Classification | Wildfires impact soils and increase the chance of landslides. |
| Wildfire Hazard Class | High impact on whether wildfires occur. |
| Surface Roughness - Wind | While surface roughness may impact wildfire spread, a direct comparison would be difficult. |
| General Construction Class | Construction class may play a role in the overall susceptibility to ignition and fire spread throughout the building. Masonry, steel and other non-combustible materials have limited ability to ignite. Wood and wood frame materials are at a higher susceptibility to fire spread. |
| Construction Quality | Construction quality may impact wildfire susceptibility and fire spread, however, a direct correlation is not possible |
| Building Foundation | Limited aspects of building foundations may impact wildfire risk: wood piles may be more susceptible to charring and loss of strength. Piles may also indicate an elevated structure which may increase ignition potential. |
| Soft Story | While soft stories may indicate an elevated structure, which increases the chance of ignition, we cannot surmise if the soft story occurs due to elevation or is in an enclosed structure. |
| Building Condition | Building conditions may indicate a propensity for wildfire ignition. |
| Floor System | Floor systems are typically not an issue in wildfires due to the fire being exterior of the structure. |
| Cladding/Wall System | Fire-resistant cladding has a significant impact on the ignition potential of the structure. |

| Attribute | Impact on Wildfire Resistance |
|---|---|
| Roofing Material | Roofing material has a significant impact on the ignition potential of the structure. |
| Roofing Description | May provide details on roofing that would impact ignition potential. |
| Roof Deck Material | Roof deck material is part of the fire resistant system of a roof and may impact fire spread and ignition potential. |
| Roof Geometry | Roof geometry plays a role in the amount of debris that may accumulate or where fire brands may get stuck, increasing the potential for ignition and fire spread. Roof geometry may also increase the radiant heat from one portion of the roof to another, increasing fire spread. |
| Roof Drainage System | Drainage systems may often trap debris increasing the propensity for ignition. |
| Roof Structures | Different appendages on a roof may increase the risk of ignition and fire spread. |
| Roof Screens/Signs Anchorage/Bracing | Vertical elements on a roof increase the surface area and may serve to trap embers and debris. |
| Roof Solar Panels Anchorage/Bracing | Solar panels can trap debris under the panel and increase the chance of ignition. |
| Window & Frame Type | Windows are a highly vulnerable aspect of a building. Limited studies have been done on how missile or pressure-resistant windows perform in wildfires. Information collected in this attribute does not include attributes like fire resistance rating. |
| Glass Percentage | Buildings with more windows may be more susceptible to ignition due to window breakage. |
| Window Glazing Protection | Windows are highly vulnerable and those with engineered shutters may reduce the breakage, limited fire spread. |
| Door & Frame Type | Doors are a highly vulnerable aspect of the building. Non-combustible doors may limit fire spread. |
| Glass Type | Windows are a highly vulnerable aspect of a building. Annealed, tempered, heat strengthened, laminated and IGU may decrease the chance of breakage. |
| Building Exterior Opening | Buildings with more windows and doors, where unprotected, may increase the chance of fire spread |
| Roof Structures | Roof structures may impact the potential for ignition. |
| Accessory Structures | Accessory structures may make the building more vulnerable to fire spread and ignition. |
| Chimneys | Chimneys may trap debris and increase chance of ignition. |
| Ornamentation | While anecdotal, greater ornamentation may allow for debris and therefore increase the chance of ignition. |

| Attribute | Impact on Wildfire Resistance |
|---|---|
| Building Sprinkler Type | Building sprinklers typically only protect against fires originating inside. |
| Back-up Generator | The presence of a generator may be positive if aligned with any protection measures. |
| Backup Generator Location | The location of the generator is positive if it remains in the interior of the building or is protected. Must balance with the risk of flooding. |
| Fire Protection Description | Additional details on fire protection against wildfires may be included here. |
| Hydrant Flow Test Results | Hydrant flow tests are imperative to ensure that firefighting activities can be maintained. |
| Flammable/Combustible Liquid | Combustible liquids may impact ignition potential and fire spread, specifically if stored outside. |
| Fire Detection System | A fire detection system may alert the fire department to a fire. |
| Fire Rating for Roof Covering | Provides information on whether the roof covering is Class A, B or C |
| Fire Rating for Wall Siding | Provides information on whether the wall cladding is Class A, B or C |
| Soffit | Provides information on the construction material of the soffit which may indicate combustibility. |
| Roof Overhang | Details size of roof overhang which may indicate susceptibility to fire spread. |
| Roof Vent | Provides information on whether roof vents are protected from fire. |
| Deck | Provides detailed information on the construction material of the deck which indicates the susceptibility to ignition and fire spread. |
| Fences within 5 feet | Details construction material of fences which indicates the susceptibility to ignition and fire spread. |
| Defensible Space | Provides information if defensible space is present and the distance. |
| Firewise Community Participation | Details whether the community participates in the FireWise program |
| Exterior Fuel Storage | Provides information on whether exterior fuel storage is present. |

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