



Highway Advisory Radio Flashing Beacon Sign Post Fire Resiliency

Requested by

Jeremiah Pearce, District 2, Office of ITS Engineering and Support

July 29, 2024

The Caltrans Division of Research, Innovation and System Information (DRISI) receives and evaluates numerous research problem statements for funding every year. DRISI conducts Preliminary Investigations on these problem statements to better scope and prioritize the proposed research in light of existing credible work on the topics nationally and internationally. Online and print sources for Preliminary Investigations include the National Cooperative Highway Research Program (NCHRP) and other Transportation Research Board (TRB) programs, the American Association of State Highway and Transportation Officials (AASHTO), the research and practices of other transportation agencies, and related academic and industry research. The views and conclusions in cited works, while generally peer reviewed or published by authoritative sources, may not be accepted without qualification by all experts in the field. The contents of this document reflect the views of the authors, who are responsible for the facts and accuracy of the data presented herein. The contents do not necessarily reflect the official views or policies of the California Department of Transportation, the State of California, or the Federal Highway Administration. This document does not constitute a standard, specification, or regulation. No part of this publication should be construed as an endorsement for a commercial product, manufacturer, contractor, or consultant. Any trade names or photos of commercial products appearing in this publication are for clarity only.

Table of Contents

Executive Summary 2

Detailed Findings 7

 Background 7

 Survey of Practice 7

 Related Research and Resources 11

Contacts 18

Appendix A: Survey Questions 19

Executive Summary

Background

Highway advisory radios (HARs) use flashing beacon (FB) signs and flashers to alert motorists to tune their vehicles' AM radio to receive real-time traffic incident information. HAR FB signs are a critical in-route traveler information system that provides the traveling public with necessary information that affects travel decisions during incidents such as wildfires.

To be effective, HAR FB signs must be installed next to the traveled way within the clear recovery zone (CRZ) so the signage is visible to the traveling public. To meet CRZ requirements, the mounting posts must break away or be classified as *not a fixed object*. The California Department of Transportation (Caltrans) typically uses wood box beam posts to support HAR FBs and meet CRZ requirements, but these posts are susceptible to destruction by wildfires.

Recently, Caltrans District 2 has experienced high failure rates and long repair times for the wood box beam posts used to mount HAR FB signs within wildfire boundaries. Caltrans is seeking a solution to provide signage support that will withstand fire; protect the sign panels, conduits and other HAR components from damage; and comply with CRZ requirements. Such a solution will provide continued use of HAR FBs by Caltrans traffic management centers and the traveling public and will also reduce the total cost of HAR ownership in wildfire-prone areas.

To assist Caltrans with its review, CTC & Associates conducted a survey of state transportation agencies in the western United States about agency practices to install sign supports for large-format signs located in the CRZ that can withstand the impacts of fire.

Summary of Findings

Survey of Practice

An online survey distributed to 17 of the 18 state department of transportation (DOT) members of Western Association of State Highway and Transportation Officials (WASHTO) received responses from six WASHTO members:

- Hawaii DOT
- Idaho Transportation Department
- Nevada DOT
- North Dakota DOT
- South Dakota DOT
- Texas DOT

All respondents reported on the use of metal sign posts—not the wood box beam posts used by Caltrans—and none provided information about practices to ensure fire resiliency. As the South Dakota DOT respondent commented, “I am not sure if our posts are fire-resilient. [T]hat has never been the focus, though this is something to think about for our Black Hills region where wildfire is a possibility. We have not examined any fire retardant coatings, etc.”

The Idaho Transportation Department respondent similarly stated that he is unaware of his agency implementing fire resilient measures for sign posts, noting that the agency “typically

uses galvanized steel posts for large-format signs that would provide reasonable resistance to fire.” In North Dakota, the respondent reported that the DOT has limited experience with fires around sign supports. Though prairie fires do impact roadway signs, the respondent is not aware of sign support failures.

South Dakota DOT has not installed new wood sign posts since 2015 and is replacing all existing wood posts with a metal alternative. The respondent offered additional details of the multiple perforated square steel tube posts on breakaway bases that are used for large-format signs up to 66 square feet. The agency uses structural steel for larger signs. Signs with supports that lack a breakaway feature must be outside the CRZ or protected by guardrail. The agency avoids the latter installation practice given the hazard it poses and challenges associated with snow drift.

Related Research and Resources

A literature search of publicly available domestic in-progress and published research identified a small sampling of publications and resources that are organized into the following topic areas:

- Fire retardant treatments for wood.
- Protecting geotechnical and other assets.
- Commercial fire protection products.
- Breakaway sign support systems.

The table that begins on page 5 summarizes these publications, providing the publication or resource title, the year of publication, if applicable, the publication’s topic area and a brief description of the resource. Significantly more detail about each resource can be found in the **Detailed Findings** section of this report.

Gaps in Findings

The survey received a limited response from the relatively small pool of 17 potential respondents. None of the responding agencies have experience with fire protection for the wood box beam post sign supports that Caltrans currently uses for large-format signs in the CRZ. All responding agencies use some type of metal sign post; some of these sign posts have breakaway capabilities and are crash-tested.

While an examination of relevant literature indicates current research interest in making engineered and other types of wood products resilient to fire, researchers have not addressed the fire resiliency of the wood box beam posts that Caltrans uses. In a related application, commercial vendors are producing—and utility companies are using—a range of fire treatment products to help reduce the cost of post-fire wood utility pole repair and replacement.

Next Steps

Moving forward, Caltrans could consider:

- Following up with respondents from North Dakota and South Dakota DOTs to better understand agency practices for the use of metal sign posts to support large-format signs.
 - Both agencies use perforated steel tube posts that have breakaway capabilities and have been crash-tested. South Dakota DOT uses structural steel if the sign becomes too large for multiple perforated steel tube posts.

- Consulting with one or more of the researchers examining treatments for wood products to improve fire resiliency.
- Reaching out to selected agencies not participating in the survey to determine if other agencies have experience with improving the fire resiliency of wood sign supports for large-format signs.
- Contacting Pacific Gas and Electric Company (PG&E) to learn more about the agency's pretreatment of utility poles within fire-affected areas.
- Investigating commercial fire protection products that are recommended to help reduce the cost of post-fire repair or replacement of wood utility poles to assess the products' applicability to the wood box beam posts that Caltrans uses.

Related Research and Resources

Publication or Resource (Year)	Topic Area	Excerpts from Abstract or Description of Resource
Boron-Based Polyelectrolyte Complex Nanocoating for Fire Protection of Engineered Wood (2024)	Fire Retardant Treatments for Wood	Describes an effort to reduce the flammability of oriented strand board (OSB) by depositing a polyelectrolyte complex (PEC) coating consisting of sodium polyborate and polyethylenimine using a two-dip process. Researchers found that the PEC treatment imparts self-extinguishing behavior to OSB and reduces the total heat release by 21% and total smoke release by 79% while increasing the time to ignition by 18% relative to untreated OSB.
Fire Protection of Wood with an Environmentally Benign UV-Cured Polyelectrolyte Complex (2023)	Fire Retardant Treatments for Wood	Addresses the effects of a UV-cured flame-retardant treatment deposited on plywood and natural whitewood through in situ photopolymerization of an anionic phosphate-containing methacrylate, in the presence of cationic polyethylenimine, to form a PEC. The best version of this treatment, deposited in only two steps, renders natural wood and plywood flame retardant without affecting mechanical properties.
Flame-Retardant Surface Treatments (2020)	Fire Retardant Treatments for Wood	Presents a historical overview that leads to the most promising surface treatments that will help pave the way for developing more effective and nonintrusive flame retardants in the future.
Wildfire Damage of Geotechnical Assets (2022)	Protecting Geotechnical and Other Assets	Attempts to raise awareness of the risks posed to geotechnical assets due to wildfires and encourage a proactive approach to protect structures before they are impacted.
PG&E Teams Pre-Treating Poles in Fire Areas, Helping Protect Communities, First Responders and Minimizing Outages (2020)	Protecting Geotechnical and Other Assets	Describes PG&E's spraying of PHOS-CHEK, a sticky material approved by the U.S. Forest Service for slowing or stopping the spread of wildfires, as a pretreatment for hundreds of utility poles within fire-affected areas.
Whole-House Fire Blanket Protection from Wildland-Urban Interface Fires (2019)	Protecting Geotechnical and Other Assets	Investigates the use of thin fire blankets as a house wrap in the laboratory and prescribed wildland fires. Key success factors: <ul style="list-style-type: none"> • The fire blanket's heat-blocking capability. • Endurance under severe heat-exposure high-wind conditions. • Proper installation.
Fire Resistant Fire Shields (Firezat, Inc., 2024)	Commercial Fire Protection Products	Used to protect buildings. Reusable and can be deployed in strong winds without tearing; withstands extremely high winds with chicken wire applied over the wrap.
Fire Mesh: Fire Retardant Net Barrier (Genics, 2024)	Commercial Fire Protection Products	Describes an innovative net designed to protect wood products in case of fire by forming a protective barrier that stops the spread of flames. Used to protect utility poles as well as railroad bridges and crossarms.

Publication or Resource (Year)	Topic Area	Excerpts from Abstract or Description of Resource
ArmorBuilt Wildfire Shield (Hexion, 2024)	Commercial Fire Protection Products	Describes a covering that swells and seals around a wood utility pole to create a protective and effective heat insulation barrier.
ArmorBuilt Wildfire Shield (Osmose, 2023)	Commercial Fire Protection Products	Describes a heavy-duty fire-retardant mesh designed to protect wood poles from fire damage. An intumescent coating fuses with a fiberglass mesh to provide charring and flame resistance by forming a protective layer around the wood pole.
ArmorBuilt Wood Pole Wildfire Shield (Osmose Utilities Services, Inc., 2024)	Commercial Fire Protection Products	Provides more details of the product's features and installation.
Fire-Guard (Osmose, 2023)	Commercial Fire Protection Products	Describes a heavy-duty coating designed to protect all species and treatments of wood utility poles from fire damage. Latex-based formula "provides excellent flame resistance and can withstand years of outdoor weathering." Available in spray-on and brush-on formulas.
Fire-Guard Wood Pole Protection (Osmose Utilities Services, Inc., 2021)	Commercial Fire Protection Products	Provides more details of the product's features and installation.
FireGuard Wildfire Protection System (SEITec Inc., 2021)	Commercial Fire Protection Products	Presents a fire-resistant fabric (aluminized structure wrap) that shields against wildfires. Aluminum surface reflects more than 95% of radiant heat while the inflammable heat-resistant fabric provides thermal insulation.
Wildland Fire Safety (Perimeter Solutions, 2024)	Commercial Fire Protection Products	Presents a range of products, including wildland fire chemicals PHOS-CHEK and FIRE-TROL brand long-term fire retardants, and Class A foams and gels.
Crashworthiness and Protection of ITS Field Devices (2014)	Breakaway Sign Support Systems	Provides guidance for the deployment of crashworthy sign supports for intelligent transportation system (ITS) devices, including FB systems. All support systems specific to FB systems are metal.

Detailed Findings

Background

Highway advisory radios (HARs) use flashing beacon (FB) signs and flashers to alert motorists to tune their vehicles' AM radio to receive real-time traffic incident information. HAR FB signs are a critical in-route traveler information system that provides necessary information during incidents such as wildfires that affects travel decisions.

HAR FB signs are installed within the clear recovery zone (CRZ), next to the traveled way, to ensure the signage is visible to the traveling public. To meet CRZ requirements, the mounting posts must break away or be classified as *not a fixed object*. The California Department of Transportation (Caltrans) typically uses wood box beam posts to support HAR FBs and meet CRZ requirements, but these posts are susceptible to destruction by wildfires.

Over the last four years, Caltrans District 2 has experienced high failure rates and long repair times for the wood box beam posts used to mount HAR FB signs within wildfire boundaries. The cost to repair HAR FB signs can be substantial, and lengthy downtimes result when their supporting posts burn, damaging not just the sign post but the entire HAR system, which includes sign panels, FB heads, conduits and wiring. Caltrans is seeking a solution that provides signage support that will withstand fire; protect the sign panels, conduits and other HAR components from damage; and comply with CRZ requirements. This solution will allow continued use of HAR FBs by Caltrans traffic management centers, reduce the total cost of HAR ownership in fire-prone areas and inform the installation of other large-format signs composed of a two-post support system for sign panels that range in size from 72 inches to 132 inches wide by 72 inches to 108 inches high.

This Preliminary Investigation gathered literature and reporting from state departments of transportation (DOTs) about current practices to better protect HAR FBs and other large-format signs that require two posts for support and are installed in the CRZ within wildfire boundaries.

Survey of Practice

An online survey distributed to 17 of the 18 state DOT members of Western Association of State Highway and Transportation Officials (WASHTO) sought information about agency experience with fire-resilient sign posts supporting large-format signs installed in the CRZ. In addition to California, WASHTO member states include Alaska, Arizona, Colorado, Hawaii, Idaho, Montana, Nebraska, Nevada, New Mexico, North Dakota, Oklahoma, Oregon, South Dakota, Texas, Utah, Washington and Wyoming.

Survey questions are provided in [Appendix A](#).

Six WASHTO members responded to the survey:

- Hawaii DOT
- Idaho Transportation Department
- Nevada DOT
- North Dakota DOT
- South Dakota DOT
- Texas DOT

Only Hawaii DOT reported no experience with fire-resilient sign posts installed in the CRZ. The remaining five responding agencies reported on metal sign posts and not the wood box beam posts that Caltrans now uses and seeks to make more fire-resilient. None of the responding agencies employ different installation practices or use different products when placing fire-resilient sign posts supporting large-format sign panels within wildfire-prone areas.

The tables below summarize survey responses.

Idaho Transportation Department

The breakaway steel posts used for large-format signs have breakaway capabilities but have not been crash-tested.

<u>Topic</u>	<u>Description</u>
Description of sign support	Wide-flange steel posts with Break-Safe breakaway support system provided by Transpo Industries or equivalent.
Sign panel dimensions	Various dimensions; depends on load, not to exceed 3,200 pounds per post.
Permanent sign post?	Yes
Breakaway capabilities?	Yes
Crash-tested?	No
Duration of use	More than 20 years.
Temporary solution for fire resilience	None. For large-format signs, the agency typically uses galvanized steel posts that provide reasonable resistance to fire.

Nevada Department of Transportation

Metal sign posts are used for all signs. Sign supports do not have breakaway capabilities and have not been crash-tested.

<u>Topic</u>	<u>Description</u>
Description of sign support	Metal sign posts.
Sign panel dimensions	All signs.
Permanent sign post?	Yes
Breakaway capabilities?	No
Crash-tested?	No
Duration of use	Not known
Temporary solution for fire resilience	None

North Dakota Department of Transportation

Limited use is made of the large-format signs of interest to Caltrans. When used, these signs have breakaway capabilities and meet crash-test requirements identified in National Cooperative Highway Research Program (NCHRP) Report 350.

Note: American Association of State Highway and Transportation Officials (AASHTO) and Federal Highway Administration collaborated on a question-and-answer document that addresses the transition of testing guidelines from NCHRP Report 350 to the 2016 AASHTO [Manual for Assessing Safety Hardware \(MASH\)](#). A November 2021 memorandum, [Clarifications on Implementing the AASHTO Manual for Assessing Safety Hardware, 2016](#), provides details of the transition.

<u>Topic</u>	<u>Description</u>
Description of sign support	Limited use of perforated tube and W-shape sign supports; type of support depends on sign size and roadway type.
Sign panel dimensions	<ul style="list-style-type: none">• <i>Perforated tube sign supports:</i> Used for signs that are 72 inches wide by 72 inches high.• <i>W-shape sign supports:</i> Used for signs that range in size from 72 inches to 132 inches wide by 72 inches to 108 inches high.
Permanent sign post?	Yes
Breakaway capabilities?	Yes
Crash-tested?	Yes. Crash-tested using procedures identified in NCHRP Report 350.
Duration of use	Estimated at 30 years or more.
Temporary solution for fire resilience	None. While prairie fires have impacted roadway signs, sign support failures have not been noted.

South Dakota Department of Transportation

The agency stopped installing new wood sign posts in 2015 and is working to replace all existing wood posts. The perforated square steel tube (PSST) posts used for large-format signs have breakaway capabilities and have been crash-tested.

<u>Topic</u>	<u>Description</u>
Description of sign support	Agency standard is the use of PSST posts for all breakaway signs installed within the CRZ. Currently, these sign supports are the Ulti-Mate sign support system provided by Ultimate Highway Solutions.
Sign panel dimensions	For large-format signs, depending on the height of the centroid, the agency may use multiple PSST posts on breakaway bases. For example, the agency uses three 2.5-inch 12-gage PSST posts telescoped with 2.25-inch 12-gage PSST for signs up to 66 square feet if the centroid is 11 feet or lower.

<u>Topic</u>	<u>Description</u>
Sign panel dimensions (continued)	Structural steel is used if the sign becomes too large for multiple PSST posts. Posts lacking breakaway capabilities must be installed outside the CRZ or protected by guardrail. The latter type of installation is not recommended due to the hazard it poses and issues with snowdrift.
Permanent sign post?	Yes
Breakaway capabilities?	Yes
Crash-tested?	Yes. Sign supports meet the requirements of NCHRP Report 350 and may meet MASH-16. The agency has not yet reviewed and analyzed MASH testing results.
Duration of use	Steel posts have been used for many years. The agency began phasing out wood sign posts in 2015.
Temporary solution for fire resilience	None

Texas Department of Transportation

Round steel posts and steel I-beams are used to support large-format signs. The sign supports have breakaway capabilities but it is not known if they have been crash-tested.

<u>Topic</u>	<u>Description</u>
Description of sign support	Steel supports
Sign panel dimensions	Signs up to 64 square feet can be supported by two Schedule 80 round steel posts. Signs up to 448 square feet are supported by three W10x22 steel I-beams. (The depth of a W10x22 I-beam is approximately 10 inches; its width is 5.75 inches.)
Permanent sign post?	Yes
Breakaway capabilities?	Yes
Crash-tested?	Not known
Duration of use	Steel sign supports have been in use for decades.
Temporary solution for fire resilience	None

Related Research and Resources

A literature search of publicly available domestic in-progress and published research identified a small sampling of publications that are organized into the following topic areas:

- Fire retardant treatments for wood.
- Protecting geotechnical and other assets.
- Commercial fire protection products.
- Breakaway sign support systems.

Fire Retardant Treatments for Wood

“Boron-Based Polyelectrolyte Complex Nanocoating for Fire Protection of Engineered Wood,” Danixa Rodriguez-Melendez, Natalie A. Vest, Thomas J. Kolibaba, Yufeng Quan, Zhuoran Zhang, Ethan T. Iverson, Qingsheng Wang and Jaime C. Grunlan, *Cellulose*, Vol. 31, pages 3083-3094, March 2024.

Citation at <https://doi.org/10.1007/s10570-024-05773-4>

From the abstract: Engineered wood products, such as oriented strand board (OSB), are widely used as the primary structural component in both residential and commercial lumber construction, primarily due to their renewability, aesthetic appeal and excellent mechanical properties. Unfortunately, the inherent flammability of these wood-based composites poses an ongoing risk to society and the environment. In an effort to reduce its flammability, a polyelectrolyte complex (PEC) coating consisting of sodium polyborate (SPB) and polyethylenimine (PEI) was deposited on OSB using a simple two-dip process. This PEC treatment imparts self-extinguishing behavior to OSB and reduces the total heat release by 21% and total smoke release by 79%, while increasing the time to ignition by 18% relative to untreated OSB. Furthermore, the PEI/SPB coating adds little additional weight (5.8 wt%) to the oriented strand board, preserving visual aesthetics and maintaining mechanical properties. The main flame-retardant effect occurs by condensed phase action via a combination of intumescence and thermal barrier mechanisms. Improving the fire protection of OSB and other engineered wood materials through a simple and environmentally benign treatment will increase their potential as a largely renewable building material, promoting a sustainable bioeconomy.

“Fire Protection of Wood with an Environmentally Benign UV-Cured Polyelectrolyte Complex,” Sarah G. Fisher, Danixa Rodriguez-Melendez, Ethan T. Iverson, Thomas J. Kolibaba and Jaime C. Grunlan, *Polymer Degradation and Stability*, Vol. 215, September 2023. Citation at <https://doi.org/10.1016/j.polymdegradstab.2023.110467>

From the abstract: The use of wood in home and commercial structures has continued to grow in recent years, but its flammability poses a threat to lives and property. Previous attempts to flame retard wood have utilized harmful halogenated chemistries or required complex deposition methods. In this work, a UV-cured flame-retardant treatment is deposited on plywood and natural whitewood through in situ photopolymerization of an anionic phosphate-containing methacrylate, in the presence of cationic polyethylenimine (PEI), to form a polyelectrolyte complex. The influence of PEI molecular weight, PEI and methacrylate concentrations, and deposition time were investigated. The best version of this treatment, deposited in only two steps, renders natural wood and plywood flame retardant without affecting mechanical properties. Cone calorimetry reveals a significant reduction in the total heat release, average heat release rate and maximum average rate of heat release for both substrates. This environmentally benign and facile system represents a significant advancement for safe and effective flame retardant treatment of wood.

“Flame-Retardant Surface Treatments,” Simone T. Lazar, Thomas J. Kolibaba and Jaime C. Grunlan, *Nature Reviews Materials*, Vol. 5, pages 259-275, January 2020.

Citation at <https://doi.org/10.1038/s41578-019-0164-6>

From the abstract: Flame retardants mitigate the threat of fire from inherently flammable materials responsible for sustaining a high standard of living. Although bulk flame retardants have proven effective for many years, there is now increased interest in the use of surface treatments to localize flame-retardant chemistry at the exterior of a material, where combustion occurs, in an effort to preserve desirable bulk properties and minimize the amount of additive needed. This [r]eview provides a historical overview that leads to the most promising surface treatments that will help pave the way for developing more effective and non-intrusive flame retardants in the future. The way in which a fire transpires and the various chemistries and mechanisms used to counteract fire propagation are discussed. Challenges that remain to improve current flame-retardant surface treatments are also addressed, as the success of these treatments depends on the scalability, durability and ability to impart desired functionality without conferring environmental problems.

Protecting Geotechnical and Other Assets

Wildfire Damage of Geotechnical Assets, Todd G. Hansen, *Rocky Mountain Geo-Conference 2022*, November 2022.

Citation at <https://ascelibrary.org/doi/abs/10.1061/9780784484517.008>

From the abstract: What happens when wildfires burn across retaining walls, landslides, bridges, power lines, utility trenches, rockfall draped mesh, reinforced slopes or other geotechnical assets? The intent of this paper is to raise awareness of the risks posed to geotechnical assets due to wildfires and encourage a proactive approach to protect structures before they are impacted. In recent years, the United States has experienced a surge of large wildfires burning through locations with critical transportation assets. Case histories will include fire damage to [m]echanically [s]tabilized [e]arth (MSE) walls in California’s Sequoia National Park, destroyed geohazard monitoring instrumentation in California’s Ferguson Fire, and bridges burned in multiple California [n]ational [f]orests and [n]ational [p]arks. Nationally, wildfires are burning with higher intensity and year-round instead of previously assumed spot locations during only dry seasons. This means a potential increased risk of wildfire damage to geotechnical assets should be considered in design. Depending on location, topography and climate, engineers should evaluate potential wildfire damage with other extreme event criteria for existing and future geotechnical structures.

“PG&E Teams Pre-Treating Poles in Fire Areas, Helping Protect Communities, First Responders and Minimizing Outages,” Kelly Clonan, *PG&E Currents*, Pacific Gas and Electric Company, August 23, 2020.

<https://www.pgecurrents.com/articles/2911-pg-e-teams-pre-treating-poles-fire-areas-helping-protect-communities-responders-minimizing-outages>

From the online article: Members of PG&E’s Safety and Infrastructure Protection Team, or SIPT, make up teams of two IBEW [International Brotherhood of Electrical Workers] workers who have been deployed to fire areas in recent days. By pre-treating poles and other assets with retardant called PHOS-CHEK, they’re reducing the risk of poles burning and toppling over, which could block access for first responders or block exits for evacuees. The team’s efforts also reduce customer outages by helping to keep poles intact during fire.

PHOS-CHEK is a sticky material approved by the U.S. Forest Service that is ideal for slowing or stopping the spread of wildfires. It’s the same material used by fire agencies that drop it into

flames via aircraft to help extinguish fire. It is considered the safest, most effective and most environmentally friendly product of its kind.

To see how SIPT crews apply the PHOS-CHEK retardant, [click here](#).

“SIPT crews have sprayed hundreds of poles within the fire-affected areas to help keep our customers from losing power while at the same time helping to protect first responders and our infrastructure. Our 40-plus SIPT crews have experience in fire prevention and emergency medical response and are familiar with wildfire conditions,” said Ben Almario, director of Wildfire Safety Operations at PG&E.

“Whole-House Fire Blanket Protection from Wildland-Urban Interface Fires,” Fumiaki Takahashi, *Frontiers in Mechanical Engineering*, Vol. 5, October 2019.

<https://doi.org/10.3389/fmech.2019.00060>

From the abstract: Each year, fires in the wildland-urban interface (WUI)—the place where homes and wildlands meet or intermingle—have caused significant damage to communities. To contribute to firefighter and public safety by reducing the risk of structure ignition, fire blankets for wrapping a whole house have been investigated in the laboratory and prescribed wildland fires. The fire blankets aim to prevent structure ignition (1) by blocking firebrands to enter homes through vulnerable spots (gutters, eaves, vents, broken windows and roofs); (2) by keeping homes from making direct contact with flames of surrounding combustibles (vegetation, mulch, etc.); and (3) by reflecting thermal radiation from a large fire within close range (adjacent burning houses or surface-to-crown forest fires) for a sustained period of time. In the laboratory experiment, two-layer thin fabric assemblies were able to block up to 92% of the convective heat and up to 96% of the radiation (with an aluminized surface). A series of proof-of-concept experiments were conducted by placing instrumented wooden structures, covered with different fire blankets, in various fires in ascending order of size. First, birdhouse-sized boxes were exposed to burning wood pallets in a burn room. Second, wall-and-eave panels were exposed to prescribed fires climbing up slopes with chaparral vegetation in California. Finally, a cedar shed was placed in the passage of the prescribed head fire in the Pine Barrens in New Jersey. The experiments demonstrated both successful performance and technical limitations of thin fire blankets. The key success factors in protecting the WUI structure are (1) the fire blanket's heat-blocking capability, (2) endurance under severe heat-exposure, high-wind conditions, and (3) proper installation. Additional studies are needed in the areas of advanced material/layer development, blanket deployment methods and multistructure protection strategies.

Commercial Fire Protection Products

Fire Resistant Fire Shields, Firezat, Inc., 2024.

<https://www.firezat.com/index>

From the vendor website: Firezat has supplied the US Forest Service, BLM [Bureau of Land Management], and Type 1 and Type 2 [i]ncident [m]anagement [t]eams with its next generation [f]ire [s]hields since 2004. The [f]ire [s]hields are used to protect the nation's most valuable historical assets as well as private resorts, cabins, ski lodges and homes threatened by [w]ildfires. Firezat [f]ire [s]hields are reusable and can be deployed in strong winds without tearing and can withstand extremely high winds with chicken wire applied over the wrap, which is why they are the choice of professionals.

Fire Mesh: Fire Retardant Net Barrier, Genics, Inc., 2024.

<https://genicsinc.com/products/genics-fire-mesh-3x50-ft-roll/>

From the website: Introducing Fire Mesh, an innovative net designed to protect wood products in case of fire by forming a barrier of protection that stops the spread of flames. Fire Mesh is used in the protection of utility poles as well as railroad bridges and crossarms. This new, flexible, easy-to-use product is an intumescent-coated mesh that can be applied at any time to any type of wood products. Heat activated, the Genics Fire Mesh allows for airflow and breathability until activated by fire.

ArmorBuilt Wildfire Shield: Guard the Grid, Hexion, 2021.

<https://v.fastcdn.co/u/8388db0c/61253221-0-HEX-GEN-00013-ArmorB.pdf>

From the document:

Durable, Affordable and Sustainable

For more than a century, Hexion has delivered sustainable product innovations and technologies that enhance everyday life. Merging fire science and smart materials, Hexion's ArmorBuilt covering instantly swells and seals around the pole to create a protective and effective heat insulation barrier. This helps you extend the life span of wood utility poles, reduce repair costs and protect more people.

....

Heat-Triggered Protection

ArmorBuilt leverages Hexion's smart materials so that it swiftly responds to heat to form a protective barrier, dramatically reducing the risk of damage.

- Activates within 20 seconds when in contact with wildfire.
- Swells around and insulates the pole.
- Prevents burning, strength loss and pole failure.
- Withstands flames with temperatures of up to 2,100°F for [more than] 10 minutes in full exposure.

ArmorBuilt Wildfire Shield, Osmose, 2023.

<https://www.osmose.com/products-fire-protection>

From the website:

ArmorBuilt Wildfire Shield is a heavy-duty fire-retardant mesh designed to protect wood poles from fire damage. The ArmorBuilt mesh effectively protects all wood pole species and treatment combinations, including CCA [chromated copper arsenate] treated pine poles. The unique intumescent coating fuses with a fiberglass mesh that provides excellent charring and flame resistance by forming a protective layer around the wood pole in the presence of fire.

Benefits of ArmorBuilt

- **Versatile**—ArmorBuilt mesh can be installed as a single or double layer to address variable types of fuel loading situations.
- **Durable**—When properly applied, ArmorBuilt Wildfire Shield has an expected service life of more than 20 years.
- **Ease of Installation**—ArmorBuilt can be applied quickly by a two-person crew using common, corrosion-resistant fasteners.
- **Safety**—Chemical leaching tests showed no environmentally harmful compounds in the intumescent char following exposure to fire.

- Conductivity—Electrical resistance testing commissioned by the manufacturer concludes that the ArmorBuilt mesh, when applied to a wood pole, conducts/has resistance very similar to an unwrapped pole. Therefore, it does not add electrical conductivity to the pole.
- Breathable coating—ArmorBuilt does not contribute to wood pole decay.
- Serviceable—Once applied, the mesh does not interfere with the serviceability of the pole.
- Extensively tested—ArmorBuilt has been fire-tested in a variety of wildfire simulations and to proposed ASTM standards, all demonstrating excellent results.

Related Resource:

ArmorBuilt Wood Pole Wildfire Shield, Osmose Utilities Services, Inc., 2024.

<https://info.osmose.com/hubfs/ArmorBuilt%20product%20bulletin%20-%202022%20FINAL.pdf>

This brochure provides more details of the product's features and installation.

Fire-Guard, Osmose, 2023.

<https://www.osmose.com/products-fire-protection>

From the website:

Fire-Guard is a heavy-duty coating designed to protect all species and treatments of wood utility poles from fire damage. Tests have proven that the latex-based formula provides excellent flame resistance and can withstand years of outdoor weathering. Fire-Guard is available in spray-on and brush-on formulas. Safety Data Sheets and labels are available upon request.

Benefits of Fire-Guard

- Long-lasting—When applied properly, Fire-Guard products can withstand years of outdoor weathering and multiple burn incidents, depending on intensity and duration of the burn.
- Cost-effective—Fire-Guard helps reduce the cost for of post fire repairs and replacements.
- Easy to apply and dries quickly.
- Easy to clean up with soap and water.
- Safe—Fire-Guard contains no solvents, plasticizers or asbestos; has no metals or sharp edges; has near zero volatile organic compounds (VOCs); and requires no specialized training and minimal personal protective equipment (PPE).
- Serviceable—Once applied, Fire-Guard does not interfere with the serviceability of the pole. The coating is gaffable and borable so the pole can be inspected, remedially treated or repaired.

Related Resource:

Fire-Guard Wood Pole Protection, Osmose Utilities Services, Inc., 2021.

https://f.hubspotusercontent30.net/hubfs/20067784/Osmose_Nov2021/pdf/FireGuard%20product%20bulletin%20-%202021%20-%20FINAL.pdf

This brochure provides more details of the product's features and installation.

FireGuard Wildfire Protection System, SEITec Inc., 2021.

<https://www.fireguard.us/>

From the website: The use of fire-resistant fabric, known as Aluminized Structure Wrap (ASW), to shield against wildfires is a well-proven and effective technique. The aluminum surface reflects more than 95% of radiant heat while the inflammable heat-resistant fabric provides thermal insulation. Therefore, the combined effect is to prevent the structure from reaching ignition temperature when exposed to intense external heat from a wildfire.

Wildland Fire Safety, Perimeter Solutions, 2024.

<https://www.perimeter-solutions.com/en/wildland-fire-safety/>

From the website: Perimeter Solutions' PHOS-CHEK and FIRE-TROL brand long-term fire retardants, Class A foams and gels are the world's safest, most effective and environmentally friendly products available for fighting, managing and controlling wildland fires. Perimeter Solutions' wildland fire chemicals have been used by the premier fire management agencies around the world since 1963. Perimeter Solutions' innovative new products include our ultra-high visibility retardants, the world's best Class A foam and our unique fire-suppressant gel. We also offer a wide range of equipment and services.

Breakaway Sign Support Systems

Crashworthiness and Protection of ITS Field Devices, Athey Creek, ENTERPRISE Pooled Fund, March 2014.

[https://enterprise.prog.org/wp-](https://enterprise.prog.org/wp-content/uploads/Crashworthiness_Protection_ITS_Devices_Final_Rpt_March2014.pdf)

[content/uploads/Crashworthiness Protection ITS Devices Final Rpt March2014.pdf](https://enterprise.prog.org/wp-content/uploads/Crashworthiness_Protection_ITS_Devices_Final_Rpt_March2014.pdf)

This report published by the ENTERPRISE (Evaluating New Technologies for Roads Program Initiatives in Safety and Efficiency) pooled fund study examined resources available to agencies "wishing to deploy ITS devices within the clear zone [that] are responsible for ensuring that the supporting structure and ITS device are crashworthy." Researchers focused their attention on ITS devices in the following categories:

- FB systems.
- Ramp meters.
- Dynamic message signs.
- Speed detection/display systems.
- Cameras.
- Other ITS devices.
- Miscellaneous electrical details.

Appendix A, Example Design Drawings for ITS Devices with Breakaway Supports, which begins on page 18 of the report (page 21 of the PDF), includes a table that provides links to design drawings for FB systems with breakaway supports (see Table A1). While not addressing the fire resiliency of these products, the standards and plans provided may be of interest to Caltrans. Listed below are the supports examined in Table 1A:

- *Georgia DOT:* Aluminum pole with pedestal base and footing foundation used with a post-mounted flashing school assembly.
- *Michigan DOT:*
 - Ground-driven perforated steel square tube posts used for sign-mounted beacon.
 - Aluminum pole with frangible square aluminum base and footing foundation used for rectangular rapid FB at a pedestrian crossing.

- *Minnesota DOT*: Pedestal pole with breakaway pedestal base and footing foundation used for advance warning flasher design.
- *Texas DOT*:
 - Aluminum pole with pedestal base and footing foundation used for a roadside FB assembly.
 - Aluminum pole with pedestal base and footing foundation used for solar-powered roadside FB assembly.
- *Washington State DOT*: Tapered steel slat with slip base and footing foundation used for FB Type 1 signal.

Table A1 also provides details of breakaway hardware accepted for use on the National Highway System, including a flashing light warning apparatus and school zone FB system.

Contacts

CTC contacted the people below to gather information for this investigation.

State Agencies

Hawaii

Ryan Nakata
Oahu District Engineer
Hawaii Department of Transportation
808-831-6700, ryan.a.nakata@hawaii.gov

Idaho

Tyson McCoy
Engineering Assistant, District 3 Traffic
Idaho Transportation Department
208-334-8335, tyson.mccoy@itd.idaho.gov

Nevada

Jim Walker
Emergency Manager, Maintenance and Asset Management Division
Nevada Department of Transportation
775-430-3588, jwalker@dot.nv.gov

North Dakota

Craig Faul
Transportation Senior Manager, Maintenance Division
North Dakota Department of Transportation
701-328-2546, cfaul@nd.gov

South Dakota

Christina Bennett
Construction and Maintenance Engineer
South Dakota Department of Transportation
605-280-9665, christina.bennett@state.sd.us

Texas

Eduardo Villalon
Traffic Engineering Section Director
Texas Department of Transportation
512-945-3930, eduardo.villalon@txdot.gov

Appendix A: Survey Questions

The online survey below was distributed to 17 state department of transportation members of Western Association of State Highway and Transportation Officials.

Caltrans Survey on Large-Format Sign Post Fire Resiliency

The California Department of Transportation (Caltrans) is gathering information about the practices to encourage fire resiliency for sign posts that support large-format signs that are installed in the clear recovery zone (CRZ) to ensure visibility to the traveling public. For Caltrans, such signs include highway advisory radio (HAR) signs that support a flashing beacon that alerts motorists to tune their vehicles' AM radio to receive real-time traffic incident information.

In California, wood box beam posts are the typical solution to support HAR signs with flashing beacons. While this type of mounting meets the CRZ requirement to break away or be classified as *not a fixed object*, these mounting posts have high failure rates and long repair times when installed in wildfire-prone areas.

The survey below inquires about your agency's experience with fire-resilient sign posts supporting large-format signs installed in the CRZ. We estimate the survey will take no more than 15 minutes to complete. We would appreciate receiving your responses by **May 17**.

If someone else in your agency would be more appropriate to address questions related to this issue, please forward this survey to that person.

The final report for this project, which will include a summary of the responses received from all survey participants, will be available on the [Caltrans website](#).

If you have questions about completing the survey, please contact Chris Kline at chris.kline@ctcandassociates.com. If you have questions about Caltrans' interest in this issue, please contact Tori Kanzler at tori.kanzler@dot.ca.gov.

Thanks very much for your participation.

(Required) Please provide your contact information.

Name:

Agency:

Title/Division:

Email Address:

Phone Number:

Note: Responses to the question below determined how respondents were directed through the survey.

(Required) Caltrans is interested in installations of two-post sign panels that range in size from 72 inches to 132 inches wide by 72 inches to 108 inches high. Does your agency have

experience with **fire-resilient sign posts** supporting this type of large-format sign installed in the clear recovery zone?

- Yes (Skipped the respondent to **Fire-Resilient Sign Posts**.)
- No (Skipped the respondent to **Wrap-Up**.)

Fire-Resilient Sign Posts

1. Please describe the type of sign post supporting large-format sign panels that your agency has purchased or retrofitted with a commercial product or other solution that has proved to be fire-resilient. Please include the vendor, manufacturer, model number or other identifying information of a commercial product, if appropriate.
2. What are the dimensions of the sign panels these posts support?
3. Are these sign posts permanent?
 - Yes
 - No (Please describe the temporary uses of these sign posts and the permanent posts that replace them.)
4. Do the permanent fire-resilient sign posts provide breakaway capabilities during a collision?
 - Not applicable
 - Yes
 - No
5. Have the permanent sign posts been crash-tested?
 - Not applicable
 - No
 - Yes (Please describe crash-test results.)
6. How long has your agency used these permanent fire-resilient sign posts?
7. Does your agency implement a temporary solution for sign posts installed in fire-prone areas that are not fire-resilient (for example, untreated wood posts)? Such a solution might involve treating these sign posts with fire retardant material just before an imminent fire.
 - No
 - Yes (Please describe this process.)

Assessment

1. Please describe your agency's experience when placing fire-resilient sign posts supporting large-format sign panels within wildfire-prone areas.
2. How much maintenance is required to ensure the sign post's fire resilience remains intact?
3. Has your agency conducted any tests of the fire resiliency of these sign posts?
 - No
 - Yes (Please describe these tests.)
4. What recommendations do you have for another agency seeking a fire-resilient sign post for large-format signs installed in the clear recovery zone?
5. Please provide links to documents associated with your agency's use of fire-resilient sign posts for large-format signs. Send any files not available online to chris.kline@ctcandassociates.com.

Wrap-Up

Please use this space to provide any comments or additional information about your previous responses.