Wildfire-Resistant Construction & Costs in Hawaii

About CPAW

The Community Planning Assistance for Wildfire (CPAW) program works with communities to reduce wildfire risks through improved land use planning. CPAW is a program of Headwaters Economics, an independent, nonprofit research group whose mission is to improve community development and land management decisions.

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Cover image: Brent Powell with elements generated by Stable Diffusion.

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The recommendations in this document are general suggestions aimed at reducing the risk of wildfire damage to a single-family home. Implementing these suggestions does not guarantee the prevention of damage. Every property and situation is unique, and we recommend consulting with local fire authorities or professionals for advice tailored to specific conditions. The organizations that produced this report are not liable for any damages or losses that may occur by following these recommendations.

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Executive Summary

In early August 2023 the town of Lahaina and surrounding area in Maui County were devastated by catastrophic wildfires that destroyed more than 3,000 structures. The impacts to families, businesses, and communities have been profound.

In an effort to provide a resource to homeowners who want to rebuild and/or retrofit their homes to higher wildfire resistance, Headwaters Economics analyzed building materials and related construction costs in partnership with Hawaii Wildfire Management Organization (HWMO) and a Lahaina-based builder. Current building code standards used across the United States and the best available science for ignition-resistant construction were considered.

This analysis offers detailed cost estimates for upgrading a home's exterior walls, roof, deck, windows and doors, eaves, gutters, and near-home landscaping (also known as the noncombustible zone). Suggested rebuilds and retrofits were based primarily on Hawaii-specific housing trends, general homeowner material and design preferences, and structure and property characteristics.

The authors analyzed building materials available locally (e.g., at Home Depot and Lowes) and when possible, verified costs with a national database for standard construction costs. In most cases, demolition, labor, and contractor overhead are not included in building material costs.

Outcomes from this analysis suggest that building material costs for a one-story, 1,000-square-foot, single-family home for adequate wildfire resistance ranged from $20,000 to $35,000. For improved wildfire resistance using premium products, building materials costs ranged from $35,000 to $60,000, not including costs for labor, demolition, excavation, and contractor overhead. When retrofitting an existing home, individual components of the home can be selectively upgraded depending on the likely source of ignition exposure. When constructing a new home, many wildfire-resistant building material costs are comparable to non-wildfire resistant materials. Additionally, this analysis concludes that some of the most effective strategies to reduce structure vulnerability to wildfire are relatively affordable. Risk-reduction strategies such as removing flammable materials from on top of and under the deck, clearing gutter systems, removing vegetation and debris from the roof, and relocating flammable materials from underneath the home are critical maintenance tasks with little to no cost to the homeowner.

Additional wildfire-resistant building techniques, such as noncombustible fencing, enclosing eaves, maintaining a noncombustible zone, and addressing ignition vulnerabilities at deck-to-wall intersections, can further improve chances of a home surviving a wildfire.

Analyzing the costs for wildfire-resistant measures beyond five feet from the home, such as the surrounding defensible space, and the space between homes was beyond the scope of this project. However, these areas also require attention. Reducing fuels between homes, including vegetation, outlying buildings, and fencing, disrupts pathways for fire and embers to spread between neighbors. Ultimately, home and property wildfire mitigation strategies are most effective when every home in the neighborhood participates.

Introduction to Home Mitigation for Wildfire Resistance

Reducing home ignitions from wildfire requires understanding the different types of fire exposures a home might face. Homes burn down in three ways:

- Wind-blown embers traveling ahead of a wildfire can land on combustible material and ignite spot fires. Direct and indirect ember ignition scenarios are the most common cause of ignitions.
- Radiant heat from a nearby fire can ignite combustible materials. The effect of radiant heat depends upon the duration of the exposure, distance, and the intensity of the heat.
- Direct flame contact occurs when flames spread to touch a building or combustible material.

Given these various exposure types, different mitigation strategies are necessary to protect homes. Some of the most effective strategies are relatively affordable maintenance measures that can be performed by the homeowner, including:

- cleaning the roof (including the valleys) of accumulated vegetative debris and leaves;
- ensuring the area under the home is clear of debris and flammable materials;
- replacing traditional wooden lattice surrounding the area under the home with a noncombustible screen;
- routinely clearing combustible debris from gutters;
- removing combustible materials from the deck and under-deck area and relocating large flammable items (e.g., RVs, trailers, etc.) at least 30 feet from the home;
- enclosing the under-deck area with metal mesh screening to minimize debris accumulation and ember intrusion;
- maintaining a 5-foot noncombustible zone around the home and under all attached decks; and
- managing vegetation beyond the 5-foot noncombustible zone and similarly mitigating threats to other outlying buildings, sheds, and structures on the property.

More substantial modifications that effectively and affordably improve wildfire resistance include:

- replacing all exterior vents with noncombustible vents and, if possible, flame- and ember-resistant vents per building code requirements for airflow ventilation needs;
- installing a minimum 6-inch vertical metal flashing (or noncombustible cladding) on deck-to-wall and roof-to-wall intersections;
- replacing the first deck board that is parallel to the side of the home with a metal grate or metal deck board, or replacing the bottom 6 to 12 inches of exterior siding along the deck with noncombustible material;
- installing a noncombustible metal gutter guard;
- replacing bark or other combustible mulch within 5 feet of the home with pea gravel or another noncombustible material; and
- ensuring that fencing within 10 feet of the home is noncombustible.

Components with large surface areas such as roofs, decks, and siding are more expensive to replace due to the quantity of material needed and associated labor costs for demolition and installation. Yet the large surface area exposed to potential ignition sources makes retrofitting these components particularly important. In some cases, retrofitting exterior components may not require complete replacement. For example, replacing the lowest 6 to 12 inches of siding with a noncombustible material can reduce ignition potential from ground-level ember exposure without having to replace all the siding on all exterior walls.

More extensive modifications that improve wildfire resistance will range in costs depending on the dimensions, location, and unique characteristics of the home and property. These improvements include:

- replacing non-fire-retardant-treated wood shake/shingle-covered roofs with a Class A roof covering such as asphalt fiberglass composition shingles, tile, or standing seam metal;
- converting all open-eave designs to enclosed (boxed-in) eave designs and installing noncombustible vents and, if possible, flame- and ember-resistant vents;
- replacing deck boards with a more ember- and/or flame-resistant option;
- replacing single-pane windows with dual-pane, tempered glass windows; and
- modifying or replacing skylights and exterior pedestrian and garage doors as needed.

Every home is unique in site characteristics, property conditions, and structure materials and design, which influences the applicability of different wildfire-resistant construction strategies. While some homes may require the complete suite of recommended measures for improved wildfire resistance and thus cost more, many homes may only need slight modifications and structural improvements to reduce risk.

Methods & Assumptions

This study is based on current building code standards used across the United States (e.g., California's Building Code Chapter 7A: Materials and Construction Methods for Exterior Wildfire Exposure, and International Code Council's Wildland-Urban Interface Code) and the best available science for ignition-resistant construction.

A typical one-story, 1,000-square-foot, single-family home (footprint specifications measuring approximately 40 feet by 25 feet) in Hawaii was considered. The authors estimated costs for constructing the home's exterior walls, roof, deck, windows and doors, eaves, gutters, and near-home landscaping (also known as the noncombustible zone). Suggested rebuilds and retrofits were based primarily on Hawaii-specific housing trends, general homeowner material and design preferences, and structure and property characteristics. Mitigation measures for broader property management at the parcel level and minimizing fuels between homes, while critical in reducing wildfire risk to the primary structure, were beyond the scope of this project. These measures include maintaining defensible space and modifying sheds, outlying buildings, and other potential vulnerabilities.[1]

Findings are adapted from results originally published in Headwaters Economics' report, *Retrofitting a Home for Wildfire Resistance: Costs and Considerations.*[2] However, the estimated costs for most building materials in this study were determined using local Hawaii-based major construction material suppliers such as Home Depot and Lowe's. Best judgment and local guidance were provided by Lahaina-based contractors.

The authors analyzed building materials available locally and when possible, verified costs with a national database for standard construction costs. Construction costs for building materials were calculated as a per-unit value. For instance, costs to replace individual windows, including glass and frame, were calculated and reported separately from costs to replace the entire exterior wall. In structuring the analysis in this way, the intent was to recognize the discrete and diverse needs of wildfire-resistant improvements and present the information as a menu of different options and considerations.

[1] Insurance Institute for Business & Home Safety. (2023). IBHS Early Insights: Lahaina Fire – 2023. Retrieved from https://ibhs.org/wp-content/uploads/IBHSEarlyInsights-LahainaFire.pdf

[2] Barrett K and Quarles SL. (2024.) Retrofitting a Home for Wildfire Resistance: Costs and Considerations. Headwaters Economics. Retrieved from https://headwaterseconomics.org/natural-hazards/retrofitting-home-wildfire-resistance/

Because of extensive variability in site conditions, composition, design, and building materials of home construction, it is difficult to assign an explicit cost for rebuilding and retrofitting a single structure or group of structures. This research was therefore intended to provide a range of scenarios and baseline cost estimates for upgrading various components of a home for improved wildfire resistance.

During any home improvement project, underlying degradation of structural components may be exposed and require additional remediation work. For example, removing roof covering may expose a portion of degraded roofing underlayment that needs repair and replacement. Costs for unforeseen conditions are not included in this report and may increase expenses for new materials and professional contractor services.

The subsequent sections of this report provide detail about the most vulnerable aspects of different home components, recommended mitigations, and estimated costs. It is important to note the estimates do not include contractor markup costs such as labor, demolition (in the case of retrofits), overhead, and profit. Labor costs and contractor overhead can increase baseline building material costs by 60-100%. Residents and homeowners should consult local contractors for accurate, place-based construction costs.

Exterior Walls, Windows, & Doors

Description

Exterior walls and components in the wall assembly can be vulnerable if exposed to embers, flames, or prolonged radiant heat from burning items located close to the home. These exposures can ignite combustible siding and the resulting flames can spread vertically and laterally to other wall components such as windows and the under-eave area. Siding extending close to the ground can be vulnerable to ignition by embers accumulating at the base of the wall that ignite it or components in the wall assembly (e.g., wood sheathing).

With the exception of non-reinforced single- or double-hung vinyl windows, research has shown that glass is the most vulnerable component of a window during a wildfire. Vinyl frame windows are susceptible to damage from radiant heat, but this typically does not result in failure of the window. Glass in a window can break from exposure to radiant heat or direct flame contact. When glass in a window breaks, the combustible materials inside the home can be more easily ignited from the flames and/or embers that enter. Wood- and vinyl-framed windows can burn or melt when exposed to radiant heat or flames.

Doors (including window glass set in doors) and door frames can fail for the same reasons as windows. Embers can accumulate in the small gaps between the door and frame, resulting in ignition of the door-framing and weather-sealing material.

Cost & Components

Estimated cost: $9,000 - $20,000

Wildfire-resistant components included in this estimate are:

- Noncombustible siding (fiber-cement cladding with gypsum wallboard)
- Metal flashing at deck-to-wall intersections
- Metal gable vents (does not include appropriate mesh screening at < 1/8”)
- Fire-rated caulk around vent gaps
- Double paned tempered glass windows (3’ x 5’)
- Fiberglass front and pedestrian doors

- Metal garage door, sliding door, and screen door
- Metal dryer, exterior, and intake air vents

Roof

Description

Roofs are highly vulnerable to ignition due to their relatively large horizontal surface area. The exposure of roof coverings to a range of climatic conditions, including wind, rain, and sun, means the roof covering will require maintenance and eventual replacement. Many Class A fire-rated roof covering options are available (e.g., asphalt fiberglass composition shingles). A main reason the roof is vulnerable is because the roof edge—including gutters and roof-to-wall intersections where roof covering meets other materials (e.g., siding used in dormers and split-level homes)—is exposed to ember ignitions. These roof-to-wall areas must be properly protected by adding additional flashing.

For the most enhanced wildfire resistance, a standing seam steel roof can be installed. Additional optimal wildfire-resistant measures to the roof include installing a fire-resistant underlayment underneath the roof covering and using a noncombustible roofing edge (including fiber-cement fascia, metal gutters, metal gutter guards, and a metal drip edge).

Cost & Components

Estimated cost: $10,000 - $25,000

Wildfire-resistant components included in this estimate are:

- Roof surface – standing seam metal
- Underlayment
- Flat, tempered-glass skylight
- Gutters
- Roof vents – flexible roll for ridge vents

Under-Eave Area

Description

Research suggests eaves are extremely important in structure survivability. Eaves play an important role for building design but they also create vulnerabilities and pathways for the building to ignite. Embers can travel through vents in the eave into the attic or accumulate in gaps between blocking and rafters in open-eave construction. Should flames reach the under-eave area, open eaves can also trap heat. Once there is an ignition in the under-eave area, fire will spread laterally more quickly.

Vents in the under-eave area allow air to enter the attic space. During a wildfire, vent openings can allow the entry of wind-blown embers into the interior attic space. If combustible materials in the attic ignite, the house can burn from the inside out. Newer vents have been designed to resist the intrusion of flames and embers.

Best practices for ignition resistance of an under-eave area are to enclose the eave with noncombustible soffit material and install flame- and ember-resistant vents. However, given supply chain limitations for certain building materials and typical open-eave construction for homes in Hawaii, metal circular vents were priced out in this analysis.

Cost & Components

Estimated cost: $2,500 – $3,500

Wildfire-resistant components included in this estimate are:

- Metal soffit vents – circular blocking
- Fire-rated caulk around vent gaps
- Metal gutter systems including gutter guards
- Metal drip edge

Attached Deck

Description

Similar to a roof, a deck has a large horizontal surface area and can be vulnerable to embers and under-deck flames. A burning deck can expose the side of the house to extended radiant heat and/or direct flame contact. The deck walking surface and structural support members, as well as what is stored on or below the deck, are therefore important considerations.

Most commonly used deck board products (including wood and plastic composite boards) are combustible. Decks with noncombustible walking surfaces include lightweight concrete or a flagstone product. Regardless of the walking surface, decks are typically supported by solid wood joists, beams, and columns that will be vulnerable to ignition if nearby combustible materials ignite.

Enclosing the under-deck area with metal mesh screening can minimize the accumulation of vegetative debris, vegetation, and other combustible materials. If lattice is being used for the under-deck area and/or the home, it is important to replace this with a noncombustible product such as metal screening.

Cost & Components

Estimated cost: $1,000 – $4,000

- Decking surface using Trex plastic composite decking boards
- Metal flashing at deck-to-wall intersection
- Metal mesh screening to enclose the under-deck area

Near-Home Landscaping

Description

Landscaping makes the home vulnerable when it ignites and allows fire to burn directly to the home. Ignition of near-home combustible materials (e.g., mulch, plants, fencing, vegetative debris and other combustible materials) from embers allows flames to touch the home regardless of how well broader vegetation management (defensible space) has been implemented and maintained.

Reducing fuels within five feet of the home is an important mitigation strategy. The type of vegetation, mulch, and other near-home landscaping features and combustible materials in this zone including fencing, will affect the home's vulnerability to ember ignitions and the potential for radiant heat and direct flame contact. For this report, the immediate near-home landscaping (0 to 5 feet) included an

analysis for combustible and noncombustible mulch and options for a privacy fence; vegetation such as plants and trees were not included in the cost analysis.

Cost & Components

Estimated cost: $2,500 – $3,500

- Gravel mulch with weed barrier
- Metal fencing panels for first 10’ from the home

Conclusion

Outcomes from this analysis suggest that building material costs for a one-story, 1,000-square-foot, single-family home (footprint specifications measuring approximately 40 feet by 25 feet) for adequate wildfire resistance ranged from $20,000 to $35,000, depending on the design, complexity, and topography of the home. For improved wildfire resistance using premium products, building materials costs ranged from $35,000 to $60,000, not including costs for labor, demolition, excavation, and contractor overhead. When retrofitting an existing home, individual components of the home can be selectively upgraded depending on the likely source of exposure (e.g., proximity of neighbors, nearby vegetation, or other site-specific considerations). When constructing a new home, costs of wildfire-resistant materials are likely comparable to non-wildfire resistant materials.

However, this research also confirmed that effective strategies to reduce structure vulnerability to wildfire can be conducted affordably. Risk-reduction strategies such as removing flammable materials from on top of and under the deck, clearing gutter systems, removing vegetation and debris from the roof, and relocating flammable materials from underneath the home are critical maintenance tasks with very little cost to the homeowner. These types of retrofits can cost between $2,000 and $10,000 depending on the original home size and design, proximity to neighboring homes, and availability of supplies.

Ultimately, reducing the vulnerability of homes and neighborhoods to wildfire must be a collective effort. One resident can do all that is necessary to reduce the potential for home ignition, but if a neighbor does nothing, the threat remains. Home and property wildfire mitigation strategies are most effective when every home in the neighborhood participates.

Appendix A: Cost Tables

Retrofitting a Home to Improve Wildfire Resistance Home (2024)
Data Tables
Cost Estimates - October-December 2023
ABOUT THE DATA
Data are from the report Wildfire-Resistant Construction & Costs in Hawaii. Pricing is from local suppliers and *RSMeans,*a national database of construction materials, demolition, labor, and contractor O&P costs.
RSMeans is updated quarterly, includes average construction cost indices from more than 970 cities, and uses the latest negotiated labor costs for average wages in 30 major cities. Prices include the cost of material as installed (i.e., material *plus* estimated labor and contractor overhead and profit costs). In some cases, pricing was not available through *RSMeans* and costs were derived from building subject matter expert, supplier, or local distributors.
Pricing includes analyzed building material costs available locally (e.g., at Home Depot and Lowes) and when possible, verified costs with a national database for standard construction costs. In most cases, demolition, labor, and contractor overhead are not included in building material costs.
COLUMN DEFINITIONS
Assembly: major groupings, or systems, of features for the roof and exterior wall components.
NIST REF. App. Table A Tech. Note #2205: corresponding row for Structure Component per NIST Technical Note #2205, Appendix Table A (https://nvlpubs.nist.gov/nistpubs/TechnicalNotes/NIST.TN.2205.pdf)
Component: describes the part of the house that was priced.
Suggest Building Material: building material suggested for wildfire resistance.
Specifications: detail about the material and dimensions of priced costs**.**
Estimated Costs: total est. cost per unit of material for Hawaii, not including additional labor, demo, and overhead costs
Unit: the unit of measure that describes the quantity.
CY = cubic yard
Ea = each
LF = linear feet
MSF = thousand square feet
SF = square feet
SQ = squares (100 sf)
SY = square yard
VLF = vertical linear feet
Assumptions: considerations for assembly of components, suggested retrofitting strategy, and conditions for recommended building materials.
ABOUT HEADWATERS ECONOMICS
Headwaters Economics is an independent, nonprofit research group. Our mission is to improve community development and land management decisions.
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Exterior Walls

Component	Subcomponent	Suggested Building Material	Specifications	Assumptions & Notes
ASSEMBLY: Exterior Walls				
Cladding	Siding	Fiber cement	Fiber cement siding, lap siding, woodgrain texture, 5/16" thick x 7-12" wide, 6-1/4" exposure.	Assumes removal of horizontal wood clapboards. Cost similar to demo of other flammable sidings.
	Barrier wrap	Weather barrier wrap		Cost based on Tyvek basic wrap (sold as a unit=118.00/1350sq.ft.); assuming 2-story home on slope, 10% overlap, 10% loss for cuts.
	Metal flashing	Flashing for siding transition & openings	Valley flashing, sheet metal flashing, aluminum, flexible, mill finish, 0.019" thick, incl up to 4 bends	Sold as 10' sections
	Fire-rated wallboard	In addition to above 3 rows, include a layer of Type X exterior wallboard for added resilience.	Fire-rated panelized gypsum wallboard, on walls, fire-resistant, 1/2" thick, finish excluded	Sold as 4x8 sheet; $33 for 1 sheet @ 32 SF; Ensure new wallboard is protected from weather as specified by manufacturer.
Trim	Trim	Fiber cement, 5/4" x 5.5"	Demo millwork and trim, replace with HardieTrim HZ10 0.75" x 3.5" x 144" Fiber Cement Rustic Grain	Sold in 12' sections
Ext. Wall Vents	Gable vents	Metal flame- and ember-resistant vent	*Remove louvered gable vent and replace with flame- and ember-resistant vents*	This is a high-priority retrofit, very vulnerable. If roof is being replaced, this vent can be eliminated (clad over) and venting exhaust moved to ridge venting. ($420 if flame-ember resistant); any gable vent will be a metal material; prefabricated mesh screening (these are 1/8")
Ext. Wall Vents	Vulnerable crawl space vents	Metal flame- and ember-resistant vent. Increase quantity of vents as required by code.	*Metal mesh screen foundation vent*	Replace w/ corrosion resistant galvanized stee construction metal vents w/ wire mesh screening at 1/8" (ideally, suggest using 14" x 6" bonderized steel flame- and ember-resistant foundation vent [41 sq-in NFVA].) ($230 if flame- ember resistant)
Ext. Wall Vents	Dryer vents	Metal dryer vent with galvanized metal flap		
Ext. Wall Vents	Makeup air intake vent	Metal flame- and ember-resistant vent		*Flame- and ember-resistant exterior wall vents are not widely available in Hawaii and have to be special ordered.*
Ext. Wall Penetrations	Gaps w/in exterior walls	Fire caulking, apply caulk to specific locations that represent locations where embers could accumulate.	Joint sealants, caulking and sealants, acoustical sealants, elastomeric, cartridges, 1/2" x 3/4" bead in place	Price per tube

Roof

Component	Sub-Component	Suggested Building Material	Specifications	Assumptions
ASSEMBLY: Roofs				
Roof surface	Skylight	Aluminum clad or fiberglass unit with tempered glazing skylight	22" x 46" standard vented tempered skylight	Tempered laminate on exterior from V-lux. Standard size is 25" x 38" (outside). Most rectangular skylights have a roof curb (usually 2" x 6" on edge) that is fastened and flashed into the roofing material. With a metal roof, a set of flashings is designed to cover this curb and connect to the roof; includes flashing kit
Roof-to-wall intersections	Roof-to-wall siding (e.g., dormers)	noncombustible siding (fiber cement)	Fiber cement (Hardie Plank) lap siding, wood grain texture, smooth texture, 5/16" thick x 8.25" wide x 144". Assumes RS Means includes nails, caulking, and pre-finished siding	Assumes roof and step flashing are correctly installed; $1850 for one wall measuring 1,000 sq ft. (+100 sq ft as extra)
	Fascia	Fiber cement, 5/4" x 5.5"	Demo fascia, replace with HardieTrim HZ10 1" x 3.5" x 144" Fiber Cement Rustic Grain trim board.	Substituted comparable interior hardwood trim is applied. Fasteners and sealant included.
	Roof-to-wall siding (metal flashing)	Tall metal (step) flashing; keep combustible siding (>6").	Galvanized Steel step flashing; 18" x 120"; 28-gauge	If existing combustible siding at dormer or split level is kept, install tall step flashing; cut siding back to 6" from roof surface. Requires weaving new flashing with existing roof shingles; less robust and wildfire-resistant option.
Roof surface	Roof covering	Asphalt shingles, Architectural	Asphalt Roof Shingles, Premium laminated multi-layered shingles, Class A, 260-300 lb/sq, pneumatic nailed	Demo units converted from SF to SQ; assumes 1 layer of roofing to be removed and 1 layer of underlayment; assumes code-compliant roof sheathing condition existing. No change to roof penetration gaskets. (Units equal 4.96 SF). ($41.98/bundle; 1 bundle = 32.8 SF); cost estimate to reroof w/ asphalt in HI for 1,000 SF= $6-10K
	Roofing underlayment	Synthetic underlayment	Owens Corning ProArmor Synthetic Roof Underlayment	(CA Cost: UDL50 is about $185/roll, for 25SF, which = $0.89/ SF, $89/SQ; installs quickly. The cost of $245.78/roll, 225SF = $1.18/SF, which is a conservative estimate.) HI Cost = $109/roll; 2 rolls = $1100 SF
	Roofing underlayment	Weather wrap	Ice and water shield as required.	(CA Cost via RS Means)
	Roof covering	Steel roofing panels	Ribbed profile, 3' x 12' galvalume steel roof panel; 29-ga.; 3/4" rib height	Price D-profile and standing seam mech lock; cost quoted here includes 1 layer of roofing to be removed and new underlayment (both synthetic and firestopping). Metal roofing prices vary substantially based on material, labor, roof complexity, and demo costs. HI est. cost for metal reroof = $11-17K
	Roofing underlayment	Fire-resistant underlayment	VersaShield 350 sq. ft. fire-resistant roofing underlayment roll. *Required at metal roof only*	Standalone cost, if required. (CA Cost via RS Means)
Roof edge	Drip edge	Metal drip edge	Aluminum drip edge, white finish, .016" thick, 5" wide	Traditionally comes in 4-foot sections
Roof surface	Ridge Vent	Ridge vent	Flexible roll ridge vent	Traditionally comes in 4-foot sections
	Ridge Vent	Noncombustible ember- and flame-resistant ridge vent, baffle included (cap not included)	Noncombustible ember- and flame-resistant ridge vent, includes baffle (no cap)	This assumes a new roof covering install (i.e., asphalt shingles) and replacement of original plastic ridge vent with noncombustible flame- and ember-resistant ridge vents. Baffle included. Install metal ridge cap as needed. CA Cost via local suppliers, incl. est. labor & demo
	Through-roof (off-ridge) vent	Noncombustible off-ridge vent	Off-ridge, ember- and flame-resistant vent [90 sq-in NFVA]	Alternative unit: $126/SF; approx. $200 for each off-ridge noncombustible flame- and ember-resistant vent. CA Cost via local suppliers, incl. est. labor & demo

Eaves & Gutters

Component	Sub-Component	Suggested Building Material	Specifications	Assumptions
ASSEMBLY: Gutters				
Gutter system	Gutter guard	Install gutter guard	All metal gutter guard, aluminum mesh, 6" wide	Comes in 3-foot sections
	Gutters	Metal gutter system	Aluminum gutters, stock units, plain, 5" box, .027" thick	Comes in 10' sections. This does not include connectors, downspouts, endcaps, screws, etc.
	Drip edge	Install drip edge	Aluminum drip edge, white finish, .016" thick, 5" wide	Comes in 10-foot sections
ASSEMBLY: Under-Eave Area				
Open eave	Blocking between rafter tails	Firecaulk any gaps	Joint sealants, caulking and sealants, acoustical sealants, elastomeric, cartridges, 1/2" x 3/4" bead in place	Install and material cost used are similar to acoustical sealant, used around all blocking. Sometimes gaps will be present / develop between blocking and adjacent components (top place, sheathing, rafters). The purpose of the caulk is to fill any gaps that are present, making it much more difficult for embers to accumulate in these locations.
	Vents	Circular noncombustible vents	Round flame- and ember-resistant eave vent (4" diameter) (mesh) [9 sq-in NFVA].	The first story of a house is assumingly fairly easy to access; second- and third-story vent replacements will have a higher labor cost due to need for ladders and fall protection. Cost does not incl. install, demo, and labor
Enclosed eave	Soffit	Noncombustible material	Fiber cement panel siding, smooth texture, 5/16" thick	CA Cost via RS Means incl. est. demo, install, and labor
	Vents	Noncombustible vents	14" x 6" bonderized steel flame- and ember-resistant soffit vent	Using soffit reference for foundation vent.

Deck

Component	Sub-Component	Suggested Building Material	Specifications	Assumptions
ASSEMBLY: Decking				
Full decking support system	Joists and beams	Dimensional lumber PT to raise sub members to 4" min width, Aluminum clad Bitumen flashing, aluminum flashing	Double any substructure joists and beams that are 2"x dimensional so all subsurface lumber is 4"x per CA Code Chapter 7A deck renovations, add aluminum clad bitumen flashing on top of joists, solid 6" aluminum flashing around post bases.	CA Cost via local contractors incl. est. demo and labor
Decking surface	Higher-density material	Class A Fire Rating deck covering	*Varies, check w/ local fire dept. for suggested materials*	
Full decking support system	Concrete surface	Metal frame with lightweight concrete slab	Steel-framed deck and concrete paved; 16-gauge steel decking, 5"-3" lightweight concrete pad (3" in peaks, 5" in valleys), using 10'x10' deck dimensions; no new piers assumed; does not include engineering/professional services which will likely be needed.	If the deck is cantilevered from the house or free standing, the ground composition, height of the deck, and square footage will all effect the cost. The estimate used here assumes the piers are suitable for the new structure, though in most cases the increased load from steel and concrete will require adding new or additional piers. For this example we are assuming a 10'x10' deck that is 10 feet off the ground at the high point, with the ground sloping to 4' at the house side, and the deck structure is also cantilevered to the house reducing the likelihood that the new piers will be necessary.
Full decking support system	Footings	Excavation and footings	Porch or deck framing, post footing, 4' deep, 8" diameter, includes excavation, backfill, tube form & concrete	CA Cost via local contractors incl. est. demo and labor
	Metal frame	Metal framing	Porch or deck framing, steel, joists, 2" x 8" x 10'	CA Cost via local contractors incl. est. demo and labor
	Metal decking	Metal deck for concrete	Metal decking, steel, slab form, uncoated, 9/16" D, 28-gauge, type UFS	CA Cost via local contractors incl. est. demo and labor
Decking surface	Plastic composite material	Trex or Sim composite decking	Selective demolition, wood framing, deck or porch decking, replace with composite fabrications, woodgrained decking (1" X 6" X 144")	Underdeck maintenance and removal of debris is essential; cost is for polyethylene composite decking; PVC composite decking may be more costly.
Decking surface	Concrete patio	Replace deck with concrete patio	Selective demolition, wood framing, deck or porch decking replace with Structural concrete, in place, slab on grade (3500 psi), over 10000 S.F., 4" thick, includes concrete (Portland cement Type I), placing and finishing, excludes forms and reinforcing	Additional costs for complete demolition, removal of debris, and labor for pouring a concrete slab deck may increase overall costs.
	Concrete patio -- added depth of slab	Thickened edge for slab	Structural concrete, thickened edge for slab on grade (3500 psi), depth is added to and poured monolithically with slab, 8" wide x 8" deep, unreinforced, includes forms(4 uses), concrete (Portland cement Type I), placing and finishing	CA Cost via local contractors incl. est. demo and labor
Deck-to-wall	Metal grate	Metal grate adjacent to house	Selective demolition, wood framing, deck or porch decking; Aluminum replacing deck board at deck-to-wall, 9-1/2" wide, 14 ga, 2' rib	
	Metal flashing	Flashing for siding transition &	Deck Flash Barrier, 6" width, 25' length	
Steps	Stair demo	Noncombustible steps	Selective demolition, wood framing, deck or porch decking	The stair includes handrail
	Stairs		Stair, shop fabricated, steel, 3'6" wide, incl 2-line pipe railing, stringers, metal pan treads, excl concrete for pan treads, per riser	
	Handrail	Noncombustible metal railing	Selective demolition, millwork and trim, railings and balusters, replace with railing, pipe, aluminum, satin finish, 2 rails, 3'6" high, posts @ 5' OC, 1-1/4" diameter, shop fabricated	
Under-deck area	Deck screening	a) Noncombustible skirting; add ember/flame vents	Pier and post construction, install skirting (and appropriate venting since skirting will result in a crawl space). Same strategy (in terms of skirting) for mobile homes.	Suggested deck skirting assumes fiber-cement panels and installing flame- and ember-resistant vents into the panels. Spacing of piers at 48" OC with 4" clearance. Price based on 4.8' sheet
	Deck screening	b) Mesh screen skirting; no vents necessary		For most mobile homes, skirting with mesh screening is recommended. Price per 2X10 roll. 1/4 inch openings

Doors & Windows

Component	Sub-Component	Suggested Building Material	Specifications	Assumptions
ASSEMBLY: Windows & Screens				
Storm window	Storm window	Metal storm window	Aluminum, residential, double-hung, combination, storm and screen, custom, clear anodic coating, 2'-0"	Storm windows are intended to be kept on year-round if covering vulnerable window.
Wood or vinyl window	Shutter	Cover with roll-down hurricane shutter	Extruded aluminum slats, frame, manual roll down, mounted on top of exterior window. Pull down with thumb turn.	This quote is for nonmotorized shutters that are closed with a crank shaft. Price based on 4 windows 2' x 4', 1 door 8' x 10' Total SF = 32+80 = 112SF. Total = $8,862.44. The style is here: Compaqued; Qom3 Security Rolling Shutters; manual; aluminum solid single walled extruded slat profile. See more here: https://disastersafety.org/wp-content/uploads/2019/03/IBHS-Selection-Guide-for-Shutters-Other-Protective-Barriers.pdf
Exterior screens	Metal screen	Metal screen	Window screens, residential, aluminum mesh and frame, 2' x 3'	
ASSEMBLY: Windows				
Wood or vinyl window	Window	Double pane, tempered, metal-clad wood frame casement	Demo is for 12 sq ft and new window is 2'x3'; demo includes removal of trim.	Demolition could involve asbestos and require additional professional services beyond labor and material for replacement of original window. CA Cost incl. est. costs for demo and labor
ASSEMBLY: Doors				
Front or side door	Kick plate	Metal kick plate	Assuming door is 36" wide, stainless steel kick plate will be 34" x 10".	Standard size for a 10" x 34" stainless steel kick plate
	Door	Metal clad	Demo exterior door, single, 3' x 7' high, 1-3/4" thick and replace with doors, residential, steel, prehung, insulated, exterior, embossed, full panel, 3' x 7'.	
	Door	Fiberglass	Fiberglass, exterior, prehung door, 1-3/4", 36"x80"	
	Weatherstripping	Weatherstripping jamb and head	Weatherstripping, doors, metal frame, spring-type, bronze, for 3' x 7' door	All gaps, screen, vents, and other penetrations like dog doors should be addressed.
	Weatherstripping	Weatherstripping threshold	Weatherstripping for thresholds; door sweep, flush-mounted, aluminum	
Sliding door (deck)	Door	Metal clad	Doors, glass, sliding, fiberglass, premium, 5/8" tempered insulated glass, 8'-0" x 6'-8" (rough opening	Labor is approx 2 h for 2 workers including balance, level, and finishing work.
	Door	Fiberglass	Demo of special doors, sliding glass. Replace with doors, glass, sliding, aluminum, premium, 5/8" tempered insulated glass, 6'-0" x 6'-8".	Difficult to find non-vinyl sliding doors at local Hawaii suppliers
Screen door	Door	Metal clad	Doors, storm, aluminum, residential, combination storm and screen, clear anodic coating, 6'-8" x 3'-0"	
Garage Door	Door	Metal clad	Demo door, special doors, overhead, residential, 16' x 7' high, remove and replace with doors, residential, garage, overhead, sectional, metal, standard, 16' x 7',	
	Door	Fiberglass	Demo door, special doors, overhead, residential, 16' x 7' high, remove and replace with doors, residential, garage, overhead, sectional, fiberglass, standard, 16' x	CA Cost via RS Means incl. est. demo, install, and labor
Garage Door	Weatherstripping	Weatherstripping jamb and head with this rubber	Sealing only head and jam with Dura-Lift rubber seals	All gaps, screen, vents, and other penetrations like dog doors should be addressed with thick rubber; cost is based on Dura-Lift rubber seals (17') requiring two but will have excess material for most doors. $15 for Liquid Nails, caulk, and fasteners added.
	Weatherstripping	Weatherstripping threshold	Weatherstripping for garage door bottom, aluminum, clear, for 12' door	CA Cost est.

Landscaping

Component	Sub-Component	Suggested Building Material	Specifications	Assumptions
ASSEMBLY: Near-Home Landscaping				
Ground cover	Gravel	Pea gravel	3" deep, hand spread.	CA Cost est. incl removal, install, and labor
	weed barrier			Not required but commonly used.
Fence	Fence	Noncombustible material	replace first 12' of fence with metal picket flat-top panel material (4' x 6')	