

Building Materials and Design



San Diego cul de sac demonstrating house to house spread independent of landscape conditions. Photo US News and World Report.



Case Study: Cedar Fire

- Houses marked in orange burned down.
- Based on the concept of defensible space, houses 1 and 2 should not have burned down because they were hundreds of feet away from the actual fire.
- Sources indicate embers ignited the roof of one which in turn ignited its neighbor.



Systems Approach



A Systems Approach

- No one factor should be singled out. Rather, a combination of factors contribute to catastrophic structure losses, i.e., the common denominators

Ignition Resistant Structural Components

- Roofs
- Eaves
- Ventilation
- Exterior wall ratings and materials
- Fire resistance of doors
- Windows
- Skylights
- Rain gutters and downspouts
- Projections (decks, patio covers, etc)
- Internal Fire Sprinklers
- Awnings, canopies



Home Design Features



- ✓ Class “A”, non-combustible roof assembly with edge protection
- ✓ Constructed of ignition-resistant materials
- ✓ Protected eaves



Home Design Features

- ✓ Fire-resistive landscape (well-maintained)
- ✓ Dual pane or tempered glass windows
- ✓ Proper spark arresters

Roofing Systems Overview



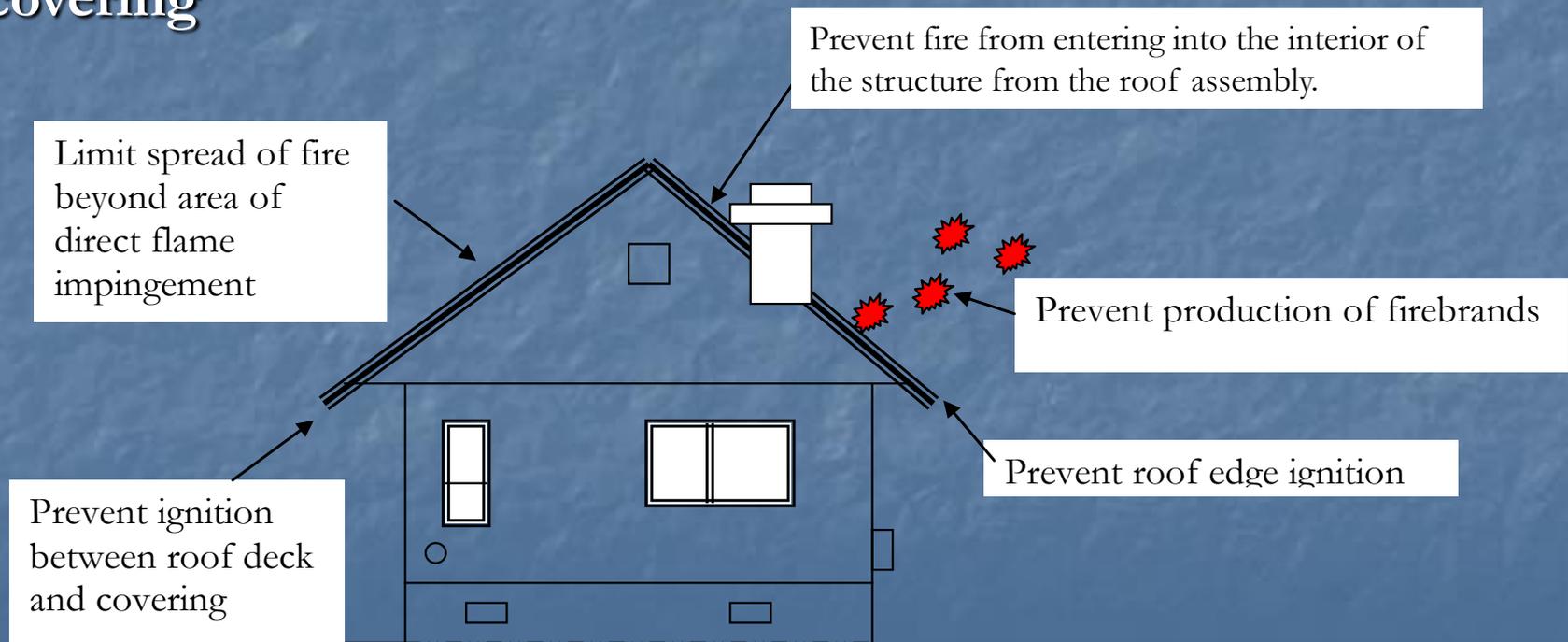
- Most vulnerable part of the house
- Wood is no good
- Tile needs complete system to be effective (cap sheets)

Above: Ranger station with wood shingle roof.
Below: Wood shingle fire, Canada.



Construction Roof Problems

- Covering combustibility
- Assembly combustibility & integrity
- Rain gutters and debris
- Entrance of Flames or firebrands between roof deck and covering



Construction Roofing



Thatched Roof



- Combustible roofs are **NOT** permitted.



Untreated wood
shake shingle



Roofing



- Roofing must be comprised of Class-A assembly, fire-resistive materials like tile, slate, cement, asphalt, or metal.

Class 'A' Metal Roof



Roofing



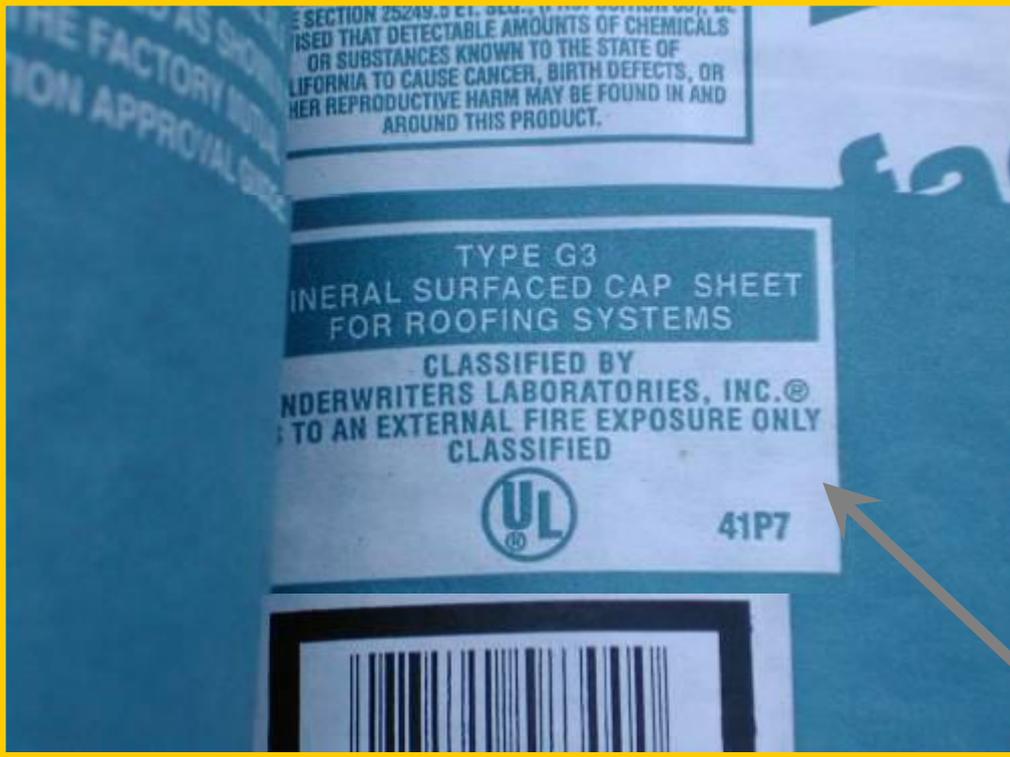
- A Class “A” roof can be obtained by covering alone (the part you can see), or as an assembly (the underlying materials)³

Class “A” Roofing



- This fiberglass asphalt comp roof has a Class “A” rating, and is based only on the covering...

Roll Roofing



External Fire Exposure Only Classified

- When using roll roofing in a fire rated assembly, make sure the material is rated for external fire exposure ...

Roll Roofing



■ *Qualification by Testing.* Material and material assemblies tested in accordance with the requirements of section 703A shall be accepted for use when the results and conditions of those tests are met. Testing shall be performed by a testing agency approved by the State Fire Marshal or identified by an ICC-ES/ICBO-ES report.⁶

Roof Edge

- Roofing alone will not save the structure.
- Roofs must also have edge protection, like bird stops or cement mud.



Edge Protection



- Roof Edge Protection systems are also designed to resist embers.
- *704A.2.3 Eave Protection. Eaves and soffits shall meet the requirements of SFM 12-7A-3 or shall be protected by ignition-resistant materials or noncombustible construction on the exposed underside.*

Fire-Resistive Eaves: Heavy Timber



Roof Eaves



- Open eaves and venting are common reasons homes succumb to wildfire.
- Boxed eaves protect attic spaces from flying embers.
- *704A.2.3 Eave Protection. Eaves and soffits shall meet the requirements of SFM 12-7A-3 or shall be protected by ignition-resistant materials or noncombustible construction on the exposed underside.*

Roof Eaves

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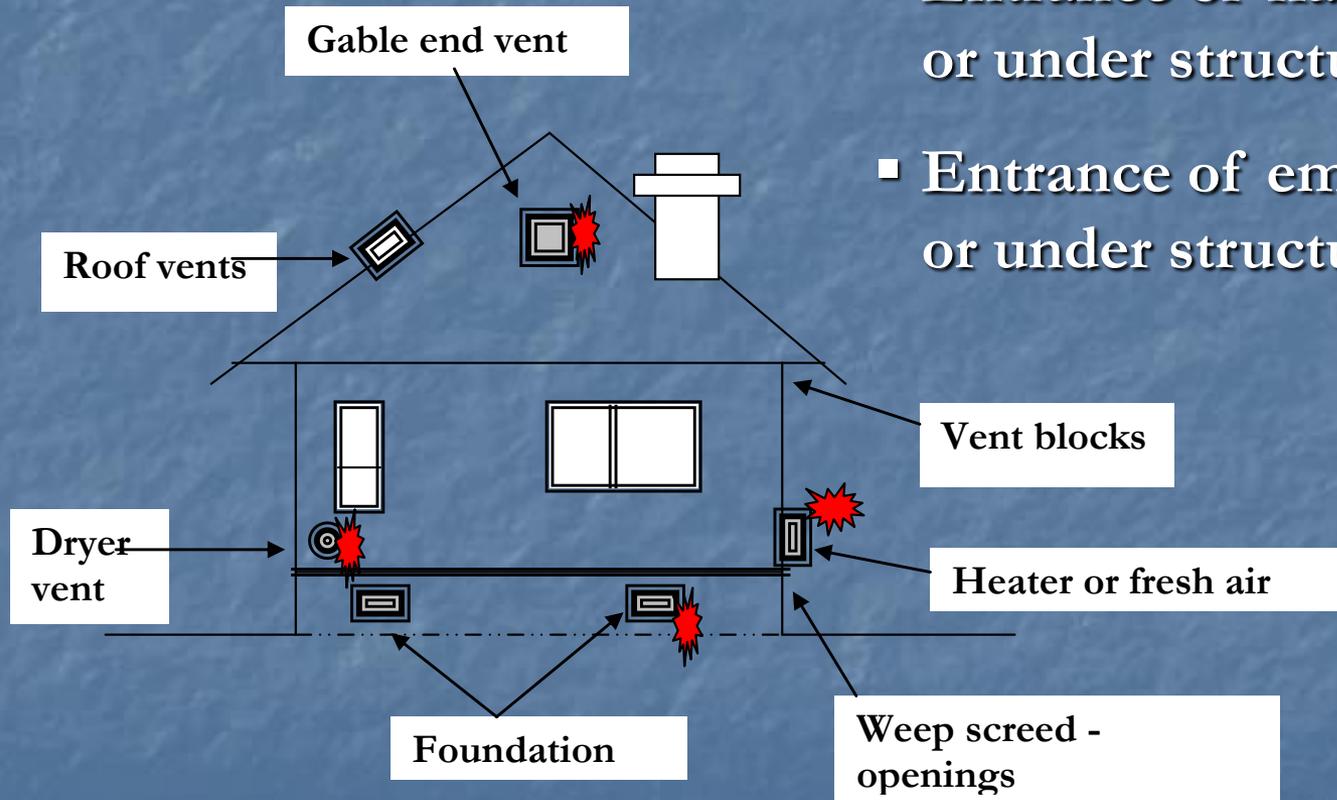


Heavy timber, notice no vents

Vents – Fire Problem

Fire Problem

- Entrance of flame into or under structure
- Entrance of embers into or under structure

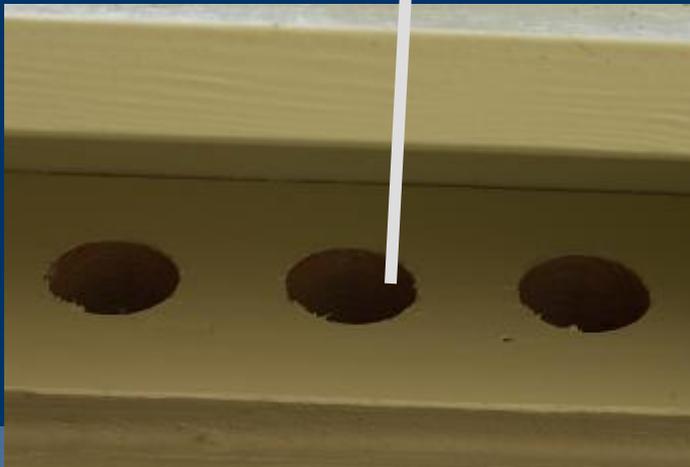


Prevent penetration from direct flame impingement

Prevent penetration from firebrand exposure

Venting

Venting is used as a moisture management tool, but vents also provide access to the structure via burning embers and flame impingement.



Venting



- Venting systems are also designed to resist embers.

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Laundry Room Vent

Attic & Underfloor Vents



- Max. 1/4" screens on vents



Venting



Lack of vents in this open eave construction contributed to this structure being saved.

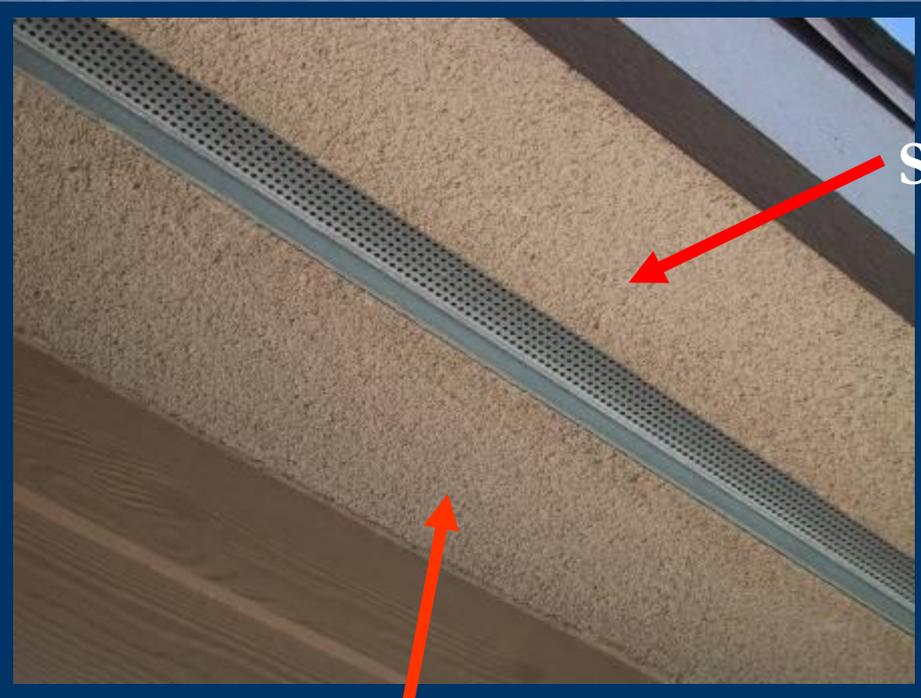


Strip Vents



Location of strip vent affects vulnerability of soffit area.

Strip Vents



Strip Vent



Non-combustible soffit material

Location of vent very important!

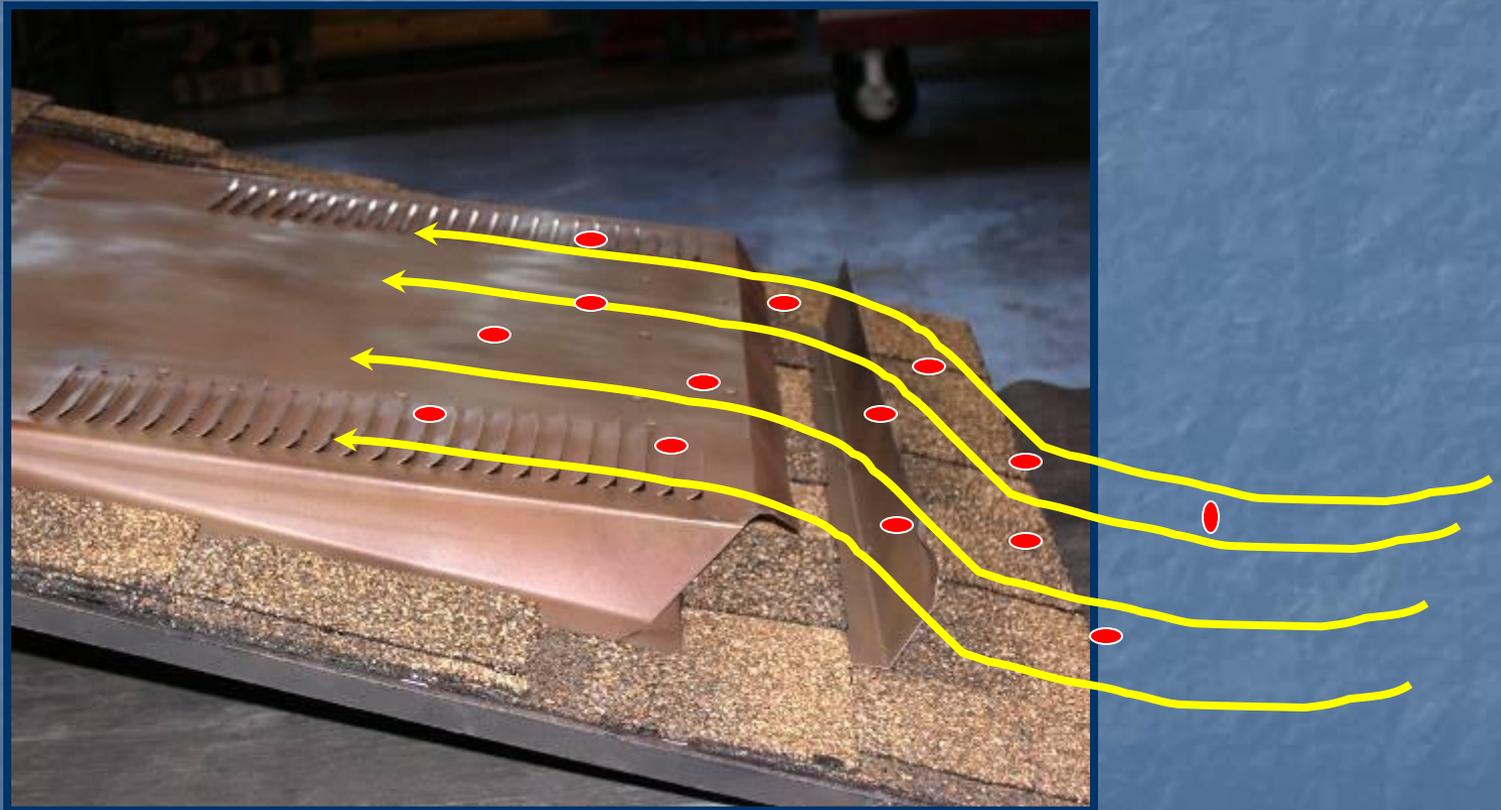
Location of strip vent affects vulnerability of soffit area.

Venting

Roof Vents



Venting Roofs



New vent design currently approved by some local jurisdictions in California.

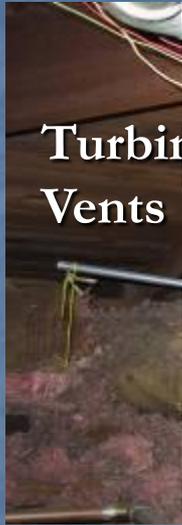
Venting

Slate and Tile



- The Harcon range of Slate and Tile roof vents is comprehensive; vents are available to match every known slate or tile, old or new.

Venting



Turbine Vents



Turbine Attic Vents with ember and ash penetrations

Turbine Attic Vents should only allow one way direction rotation and shall not spin freely!

Venting systems should be designed to resist embers.

Venting

704A.3.2.1 Exterior Wall Vents. Vent openings in exterior walls shall resist the intrusion of flame and embers into the Structure or vents shall be screened with a corrosion-resistant, Non-combustible wire mesh with ¼ inch (6 mm) openings or its equivalent.



Chimneys



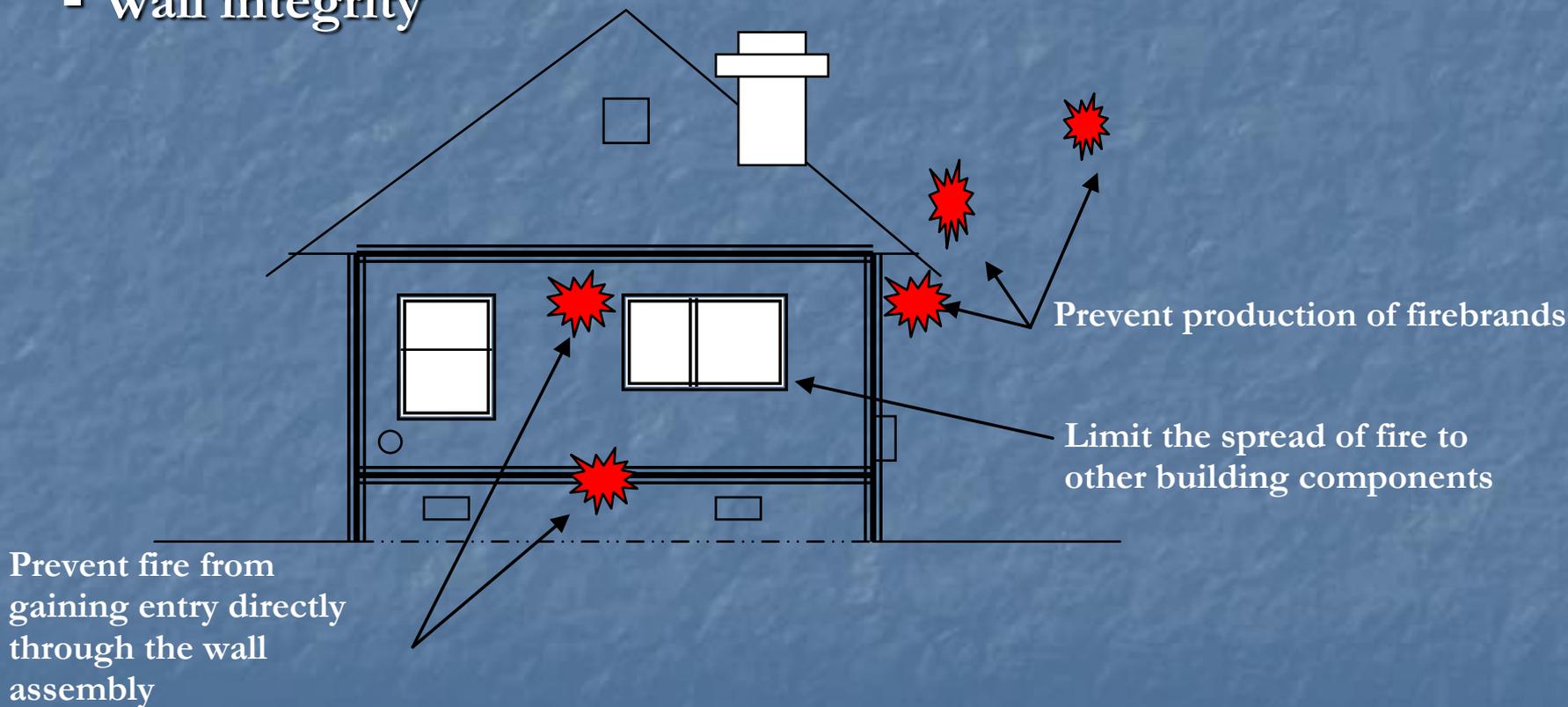
Spark arresters with a 1/2" screening are required. Keep screens maintained! Spark arresters prevent fireplace embers from igniting exterior landscape and roofing

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Wall Problems

Fire Problem

- Wall combustibility
- Wall integrity



Walls



FIRE STARTED
HERE

Exterior wall coverings. Exterior wall coverings shall extend from the top of the foundation to the roof, and terminate at 2 inch (50.8 mm) nominal solid wood blocking between rafters at all roof overhangs, or in the case of enclosed eaves, terminate at the enclosure.



Exterior Siding

- Structures must be comprised of ignition-resistant materials non-combustible material, heavy timber, or log wall construction.
- Exterior wood siding is not encouraged in communities due to their flammable nature.



704A.3.1 General. Exterior walls shall be approved non-combustible or ignition-resistant material, heavy timber, or log wall construction or shall provide protection from the intrusion of flames and embers in accordance with standard SFM 12-7A-1.

Exterior Walls: Non-Combustible



wood shingles

vs.

steel / aluminum siding



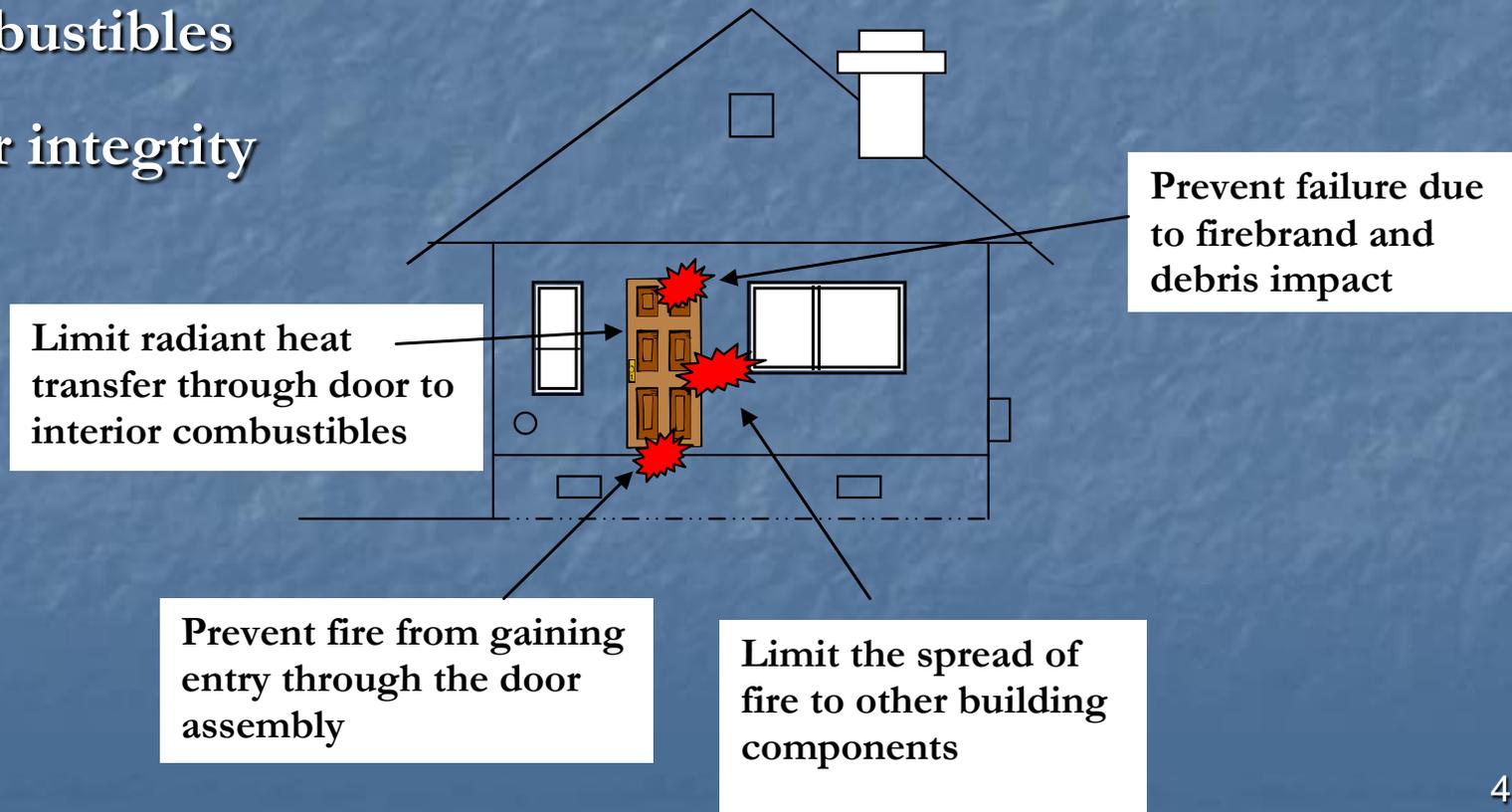
vinyl siding

warped from heat,
no embers to ignite it

Fire Problem

- Door Assembly combustibility
- Door Assembly integrity
- Ignition of door interior combustibles
- Door integrity

Door Assembly Performance





Doors Do Burn!

GAVILAN FIRE

February 10, 2002

Door Assembly: Garage Doors



- Gaps in assembly where embers can enter?
- What's stored behind the door? Boxes, papers, oil, other ignitable materials?

Windows, Doors & Skylights



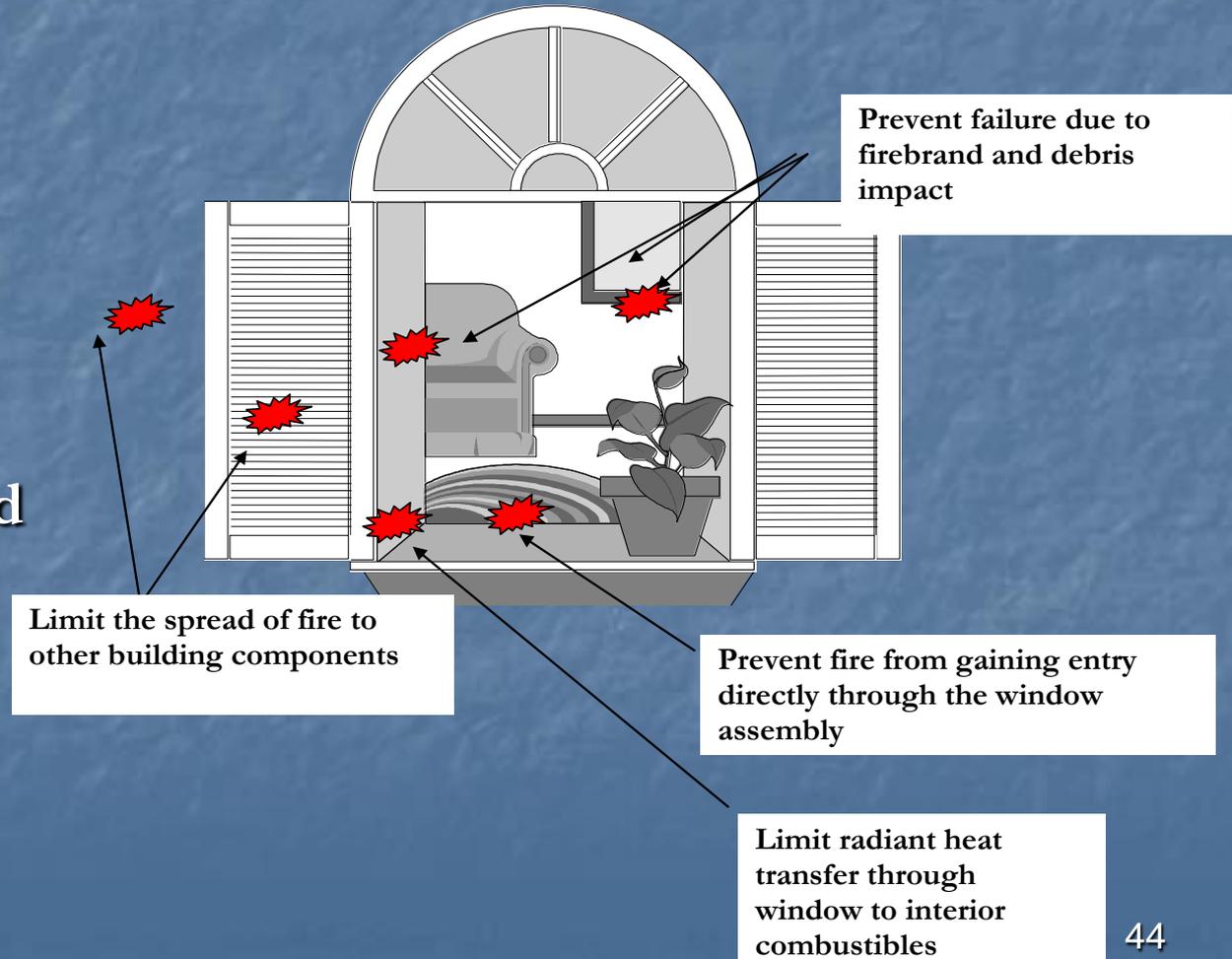
- Window glazing:
tempered or
dual glazed
(vinyl windows with
welded corners)
- Fire shutters on large
picture windows
- Doors:
solid or tempered
- Skylights:
tempered or Class 'A'

Thermal failure of window trim without loss of the double glazed materials involved.

Fire Problem

- Window Combustibility
- Window Integrity
- Ignition of interior combustibles
- Glazing Strength
 - Temper (90% HR)
 - Annealed - Standard glazing

Window Problems



Windows



- Must be dual-pane or tempered glass.
- Reduces the chance of window failure from heat and flames.
- Reduces threat of fire igniting interior drapes/curtains.

Windows



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Windows



Vinyl Window Frames

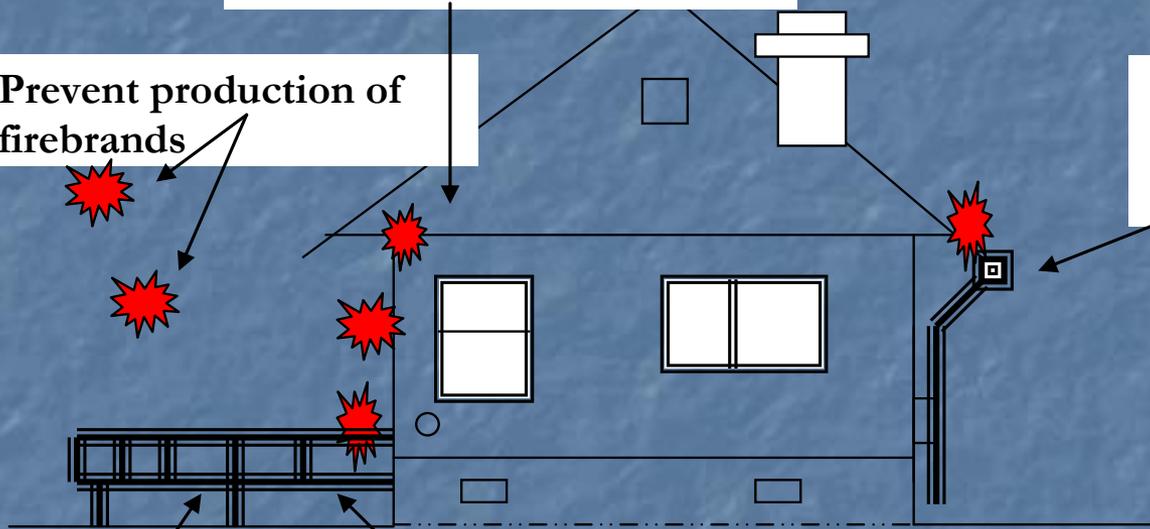
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Deck and Ancillary Assembly Performance

Limit the spread of fire to building components or other combustible materials

Prevent production of firebrands

Rain Gutters shall not contribute to fire spread



Limit ignition of deck materials and ancillary assemblies

Fire Problem

- Deck material integrity
- Material combustibility
- Material ignition

Prevent structural failure of decks

Attached Structures: Decks, Fences, Trellises, Stairs



- Non-combustible or fire-treated wood



Above: Fire traveled length of fence, broke rear window, and entered home.

Communities Development Standard Guidelines Fencing

The first 5 feet of fences and other items attached to the structure shall be constructed of non-combustible materials.



Communities Development Standard Guidelines Fencing



Non-Combustible
fencing does not
become ladder
fuel for fire which
can ignite the
overhang.

Michael J. Rogan, 09/10/2003

Decks - Balconies - Fences



Unprotected post



Composite fencing

Decks shall be constructed of Ignition-Resistant Materials and pass the performance requirements of SFM 12-7A-4, Parts A and B.

Auxiliary Structures

Communities Development Standard Guidelines



Auxiliary Structures are evaluated for a fire event (e.g. type of combustible materials, size of structure, distance from house and intended use). In addition, if structure is more than 50% covered, a Class A non-combustible roof is required.

Auxiliary Structures

Solar Panels - Pool Heating and Power Supply

Solar panels located less than 20 feet to a combustible structure shall have a metal frame; otherwise, the size and type of materials of the entire solar panel system will determine the separation distance to combustible structures.



Fire Sprinklers



Designed as a “life safety” system for residential fires.

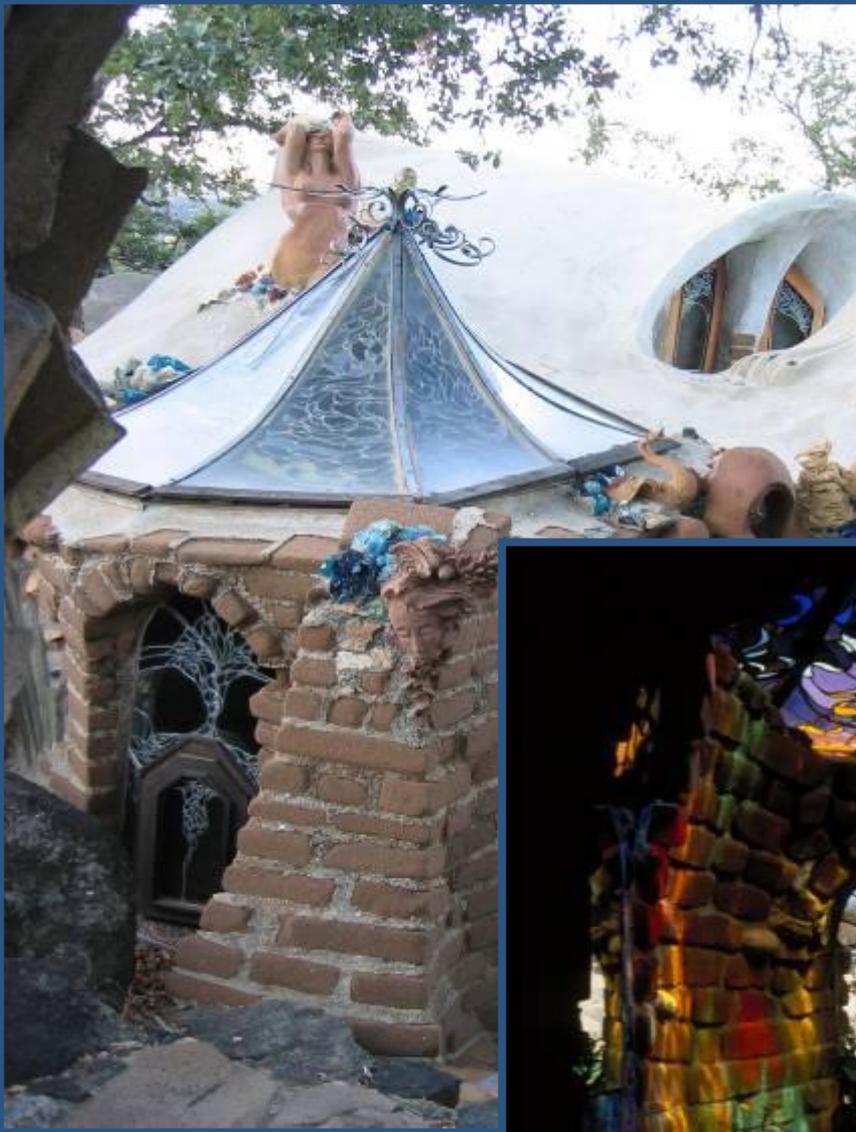


Will slow or even stop the spread of fire if embers enter the living spaces of your home.

Alternative Building Materials



Alternative Building Materials



Adobe



Hubbell Boys House



Alternative Building Materials



Autoclaved Aerated Concrete (AAC).

References

- California Building Code, 2001
- California Fire Code, 2001
- International Urban Wildland Interface Code, International Code Council, 2003
- ICC Performance Code for Buildings and Facilities - Final Draft, International Code Council, August 2000
- California's I-Zone: Urban /Wildland Fire Prevention & Mitigation, 1996
- Development Strategies in the Wildland/Urban Interface, Western Fire Chief's Association, 1991
- I-Zone Series, California Department of Forestry and Fire Protection, UC Forest Products Laboratory, 2001
- Wildfire Mitigation-Southern California Wildfires of 2003, Mitigation Success Report, FEMA, 2004

References

- Ordinance 9111 San Diego County Appendix II-A, 1999
- Structure Survival on the 1990 Santa Barbara “Paint” Fire, Foote, 1994
- “Fire Safe Building Construction for Hazardous Fire Areas”, Hunter, 2003
- “Structure Survivability”, Hunter, 2004
- Center for Fire and Research and Outreach
<http://firecenter.berkeley.edu/quarles/squarles.htm>
- Emergency Express Terms By The California Department Of Forestry (Cdf) & Fire Protection Office Of The State Fire Marshal (Sfm) To The California Code Of Regulations, Title 24
- California Building Code (Cbc), Part 2 And The California Referenced Standards Code (Crsc), Part 12 Regarding Phase Ii - Wildland-urban Interface Fire Areas Building Standards