Application of Fire Protection in Wildland-Urban Interface (WUI) Design: Hazard Definition and Current Practices

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Overview

I. Wildland-Urban Interface Fires

II. Hazard Definition

   i. Wildland Fire Behavior

   ii. Ignition Pathways

III. Current Practices

   i. Engineering Analysis

   ii. Mitigation Strategies

Introduction

- What are wildland fires?
- The wildland-urban interface – what is it?
- What hazards exist and what can be controlled?
- How can fire protection engineers contribute?

Wildland Fires

- Fires in outdoor vegetation fuels – important part of healthy ecosystems
- Wildfires increasing in frequency and intensity
  - Longer season, drier conditions, increased lightning
  - Extreme fire behavior

Wildland-Urban Interface (WUI)

- Definitions
  - IWUIC, USFA, NWCG – geographical
  - NFPA – "…potential for ignition"
- Characterization
  - Interaction between vegetation and structure fuels

Wildland-Urban Interface/Intermix

WUI Losses

- Over 38,000 homes lost since 2000
- Cost of WUI fires in 2009 estimated $14 billion

- Witch and Guejito (2007) Case Study
  - Destroyed 74 of 245 homes in fire perimeter
- Waldo Canyon (2012) Case Study
  - Almost 350 homes destroyed

Wildland Fire Behavior

- Topography
  - Slope and land features
  - Aspect
- Fuel
  - Vegetation type and density
  - Moisture content
- Weather
  - Wind
  - Relative Humidity

Hazard Definition for WUI

- Fire exposures
  - Flames
  - Fire brands
- Ignition potential
  - Susceptible fuel
  - Material flammability

Project Considerations

- Scope of project – individual structure or community protection
  - Different goals and objectives
- Type of construction – new or existing
  - May influence mitigation options
- Local regulations – codes and standards

Site review

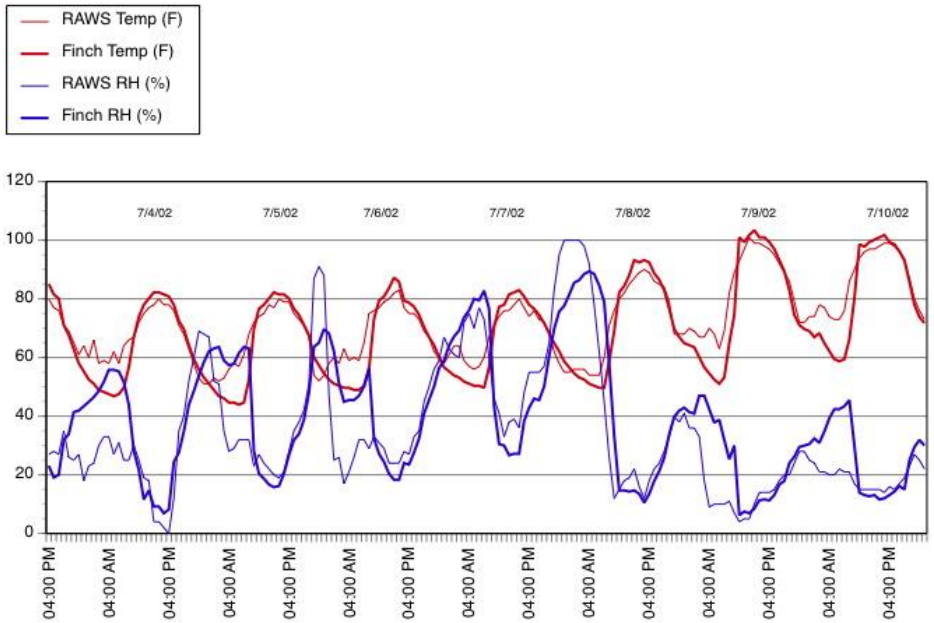
- Topography – slope and aspect
- Fuel – fire behavior fuel module, moisture content
- Weather – prevailing wind, relative humidity, extreme conditions
- Accessibility and egress
- Fire history

Topographical Map

Anderson's Fuel Models

FUEL MODEL	TYPICAL FUEL COMPLEX
	Grass dominated
1	Short grass (1 ft)
2	Timber (grass understory)
3	Tall grass (2.5 ft)
	Chaparral and shrub fields
4	Chaparral (6 ft)
5	Brush (2 ft)
6	Dormant brush, hardwood slash
7	Southern Rough
	Timber litter
8	Timber litter with normal dead
9	Hardwood litter/Open pine with grass
10	Timber litter with heavy dead
	Slash
11	Light logging slash
12	Medium logging slash
13	Heavy logging slash

Historical Weather Data



Fire Behavior Analysis

- Flame length and rate-of-spread (ROS)
  - simple models using fuel module and wind speed
- Transition from surface to crown fire
  - rapid increase in ROS and fire spread
- Wildland fire modeling
  - stochastic and finite

Surface Fire

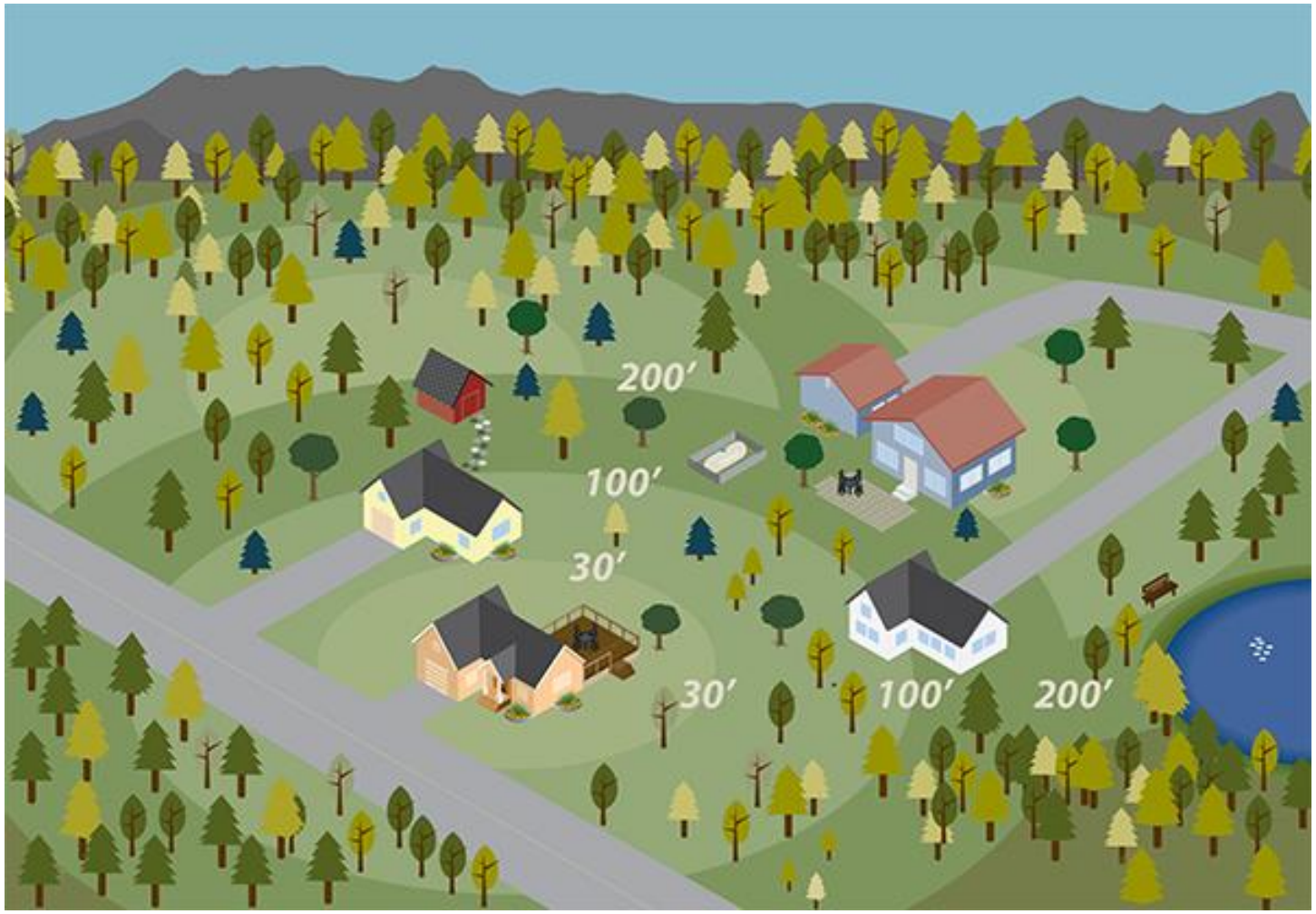
Crown Fire

Fire Exposures

- Radiant and convective heating from flames
  - Distance between crown fuels and structure
  - Fire carrying fuel adjacent to structure
- Fire brands are generated from burning fuels and carried ahead of flame front
  - Small crevices and spaces where firebrands can accumulate

Home Ignition Zone

- Zone 1 – 30 ft.
  - Limited combustible vegetation
- Zone 2 – 100 ft.
  - Fuel break
- Zone 3 – 200 ft.
  - Fuel reduction



Mitigation Strategies

- Increase accessibility for firefighters and evacuation
- Fuel modification to reduce fire intensity and prevent crown fires
- Community education and involvement for maintenance

Mitigation Strategies

- Defensible space
  - Home Ignition Zone
  - Distance between structures
- Fire-resistant building materials
  - Roof
  - Siding
  - Openings

Hazard Assessment

- Relative risk compared to other local structures
- Qualitative and quantitative
- Risk mapping
- Consider cost/benefit of mitigation strategies
- Feasibility of strategies based on new/existing construction

Conclusions

- Increasing frequency and intensity of wildfires
- Hazards of wildfires
  - Ignition pathways
  - Structure susceptibility to fire loss
- FPEs have tools and skillsets for these projects
  - Fire analysis
  - Hazard assessment