

Investigating Firefighting Gear for Wildland-Urban Interface (WUI) Application

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Introduction

The Wildland-Urban Interface (WUI) is the area where wilderness meets structural development. Firefighting calls in WUI environments provide challenges for responders due to the sharp contrast in equipment and tactics used for wildland and structural firefighting. Response to WUI areas requires personal protective equipment (PPE) that allows the firefighter to freely move during tasks while protected against burns from nearby fire conditions, but not become weighed down by overheating or exhaustion. Wildland firefighters train and maintain their physical fitness in order to withstand the extended duration of wildfire responses. Wildland gear provides an adequate mobility level to perform tasks, though firefighters can still experience extreme physical exertion due to difficult terrain, changing scene status, and weather impacts. Despite the higher fire protection available from wearing structural turnout gear, it cannot realistically be used in the WUI environment for extended periods of time due to the increased thermal and mechanical burden given by the multi-layered garment structure. This work aims to identify PPE used currently in the field and to research adaptable PPE options for firefighters working in a WUI response.

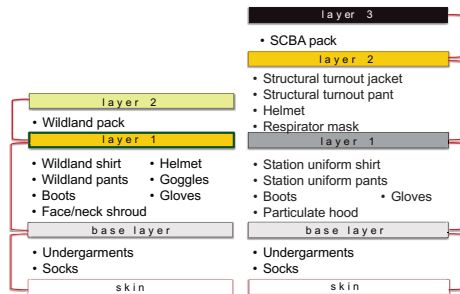


Methods

For the selection of potential options for adaptable PPE components for WUI application, comparisons needed to be drawn between the two types of PPE carried by firefighters responding to WUI response areas. One of the major differences observed between wildland gear and structural turnout was the number of layers in each ensemble set. Standards from the National Fire Protection Association (NFPA) provided base guidance for selection in wildland and structural firefighting responses. An initial workshop was conducted with firefighters to gather thoughts and experiences related to the given topic of usability and interoperability for firefighter protective ensembles. Additionally, a critical review of the literature regarding WUI PPE was performed through review of literature regarding PPE.

Results

Wildland Gear	Wear Duration	Structural Turnout
Days to weeks	Response Area	Minutes to hours
Rural (wilderness, low/no population areas)	Response Area	Urban (cities, high population areas)
Axes, hand tools, digging/scraping	Tools	Ladder, axe, hose, pike, flashlight
NFPA 1977	PPE Standard	NFPA 1851
NFPA 1140	Response Standard	NFPA 1700



Conclusions

- There is a need for an intermediate garment between wildland gear and structural turnout for Wildland-Urban Interface firefighting application.
- Layering materials has been proven to increase thermal protection and could be a potential solution for WUI PPE.
- Layer wise, 1st layer for wildland and structural turnout are similar structurally.
- For a viable PPE component for WUI firefighting, building a PPE system including the wildland PPE gear and a modular piece to increase thermal protection would be better than using structural turnout and building back towards more mobility.



Discussion

During the initial workshop, anecdotes were shared by the firefighters regarding their general experiences with PPE and usability. A general theme that emerged was that in both structural and wildland responses concerns centered around the performance characteristics of their gear in laboratory tests. Examining layering in these PPE components is logical and useful because of the direct impact seen in literature that layering can have on thermal protective performance (TPP), total heat loss (THL), garment weight, flexibility, and overall durability. Despite individual pieces of PPE meeting performance standards, firefighters expressed concerns with the overall performance of PPE on a system-level due to interactions between those individual pieces of equipment. System-level performance has been explored in literature for both wildland gear and structural turnout to an extent, with data being related to giving realistic predictions of user physiological responses. Fire departments responding to WUI environments are already using and modifying components of wildland and structural PPE to meet their needs in the short term. Some firefighters advised that they would change the wildland shirt for a turnout jacket for “upgraded” calls related to structure fires in the WUI. However, there have also been concerns regarding cross-contamination and this type of layering approach. From both the firefighter anecdotes and literature, it is very apparent that analyzing the layering of these PPE components being already used in the field will build a strong foundation for system-level understanding for the WUI application.

Future Work

This research was performed as part of a system-level project examining firefighter PPE performance. Future work includes deploying a survey for firefighter attitudes related to their PPE and interviews with WUI firefighters regarding their experiences with PPE. Material level testing on PPE materials will also be performed, as well as system level evaluations using manikin to obtain data relating to mobility, ergonomics, and general user wear potential experience. Additionally, one-on-one feedback interviews will be conducted with WUI firefighters and administration to assess the feasibility of a modular/layered addition to the wildland PPE standard equipment for the WUI application.