The Effects of Building Codes on Wildfire Outcomes within the Eaton and Palisades Burn Areas

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Abstract

On January 7, 2025, the Palisades and Eaton fires resulted in 30 deaths, destruction of over half of the housing stock, and damage estimates of $28 to $54 billion. Damage of such magnitude leads to questions on what policies might be implemented to avoid such losses in the future. One strategy for increasing resilience to fire damage is to make buildings and their surroundings more fire resistant. This paper examines the impacts of building codes on the severity of fire damage using data from the Palisades and Eaton fires. There were two major changes in building codes to increase fire resistance. The first was in 1992 after the Oakland fire, and the second was in 2008 in response to the increasing frequency of wildfires. Using age of structure as our proxy for regulation changes, we estimate models of structure survival as a function of structure vintage, controlling for other factors. We find that the 1992 regulations had a positive and significant effect on survival, likely due to increased construction quality. The effects of the 2008 regulation did not have a significant effect, possibly due to the small sample size of structures built after 2008. Other important factors include slope and building density. Proximity to structures reduces survival, likely because fire can more easily travel from one structure to the next. However, building size increases survival. We conclude that public policy matters in managing damage risk in high fire danger zones.

Introduction

On January 7, 2025, a tragic combination of a parched landscape and near-hurricane force winds resulted in some of the most damaging wildfires ever experienced in California. The two largest wildfires – the Palisades fire in the Pacific Palisades and Malibu, and the Eaton fire in Altadena – covered a combined 37,469 acres (about 59 square miles) and resulted in 30 deaths (Western Fire Chiefs Association, 2025). Nearly 16,000 structures were destroyed – over half of the housing stock. Estimates of the costs of the January 7 wildfires range from $28 to $54 billion (Southern California Leadership Council & Los Angeles County Economic Development Corporation, 2025). Wildfire damage of such magnitude naturally elicits questions about how damage can be prevented or reduced, and what policies might be implemented to avoid similar events in the future.

In this paper, we examine the impact of building codes on the severity of fire damage. Regulations to increase the fire resilience of buildings have evolved over time, starting with regulations on "defensible space" in the 1960s. The 1991 Oakland Hills Fire, which resulted in 25 deaths and destroyed 2,500 structures, motivated the state mapping of fire hazard zones and the development of building code regulations governing the construction materials and vegetation used in these hazard zones. State-level regulation was further expanded in 2008. In 2008, Los Angeles County amended its 2007 building code to incorporate updates to fire safety regulations, particularly in response to the increasing risks of wildfires. The provisions took into account California's Wildland Urban Interface (WUI) to identify buildings in fire-prone areas and create stricter regulations. Regulations mandated the use of fire-resistant building materials, automatic sprinkler systems in both commercial and residential new-builds, carbon monoxide detectors, and minimum clearance regulations to ensure fire department access.

The Palisades and Eaton fires provide an opportunity to examine whether structures built after 2008 were more likely to survive the fire than those built before. We test this hypothesis by estimating models of structure survival as a function of structure vintage, controlling for other factors that would affect the likelihood of a building being destroyed. We find that the 1992 building regulations had a significant effect on the likelihood of a structure surviving the fire, controlling for other factors, but the 2008 regulations did not. The 1992 regulations increased construction quality, likely making structures more fire resistant. The 2008 results may be due to small sample size, especially for the Eaton fire area. We find that slope is another important factor: steeper slope is associated with greater likelihood of property destruction. We also find building density (the distance between structures) to increase the likelihood of damage. However, building size works in the other direction, with larger buildings less likely to be damaged. We conclude that public policy matters in managing damage risk in high fire danger zones.

The remainder of this report is organized as follows. First, we summarize the literature on building construction and fire resilience. Second, we discuss our data sources and methodology. The third section presents our analysis and findings. The final section presents conclusions and policy implications.

Literature Review

Wildfire building codes establish standards for materials, assembly, and maintenance to promote structural resilience. These standards are typically based on results from laboratory experiments and computer simulations of structure and material performance under wildfire-like conditions (Headwater Economics, 2018). The multi-dimensional nature of wildfire ignition and spread, however, may complicate the connection between the laboratory and reality (Mell et al., 2010). For example, defensive actions taken by firefighters or property owners may affect a structure's likelihood of surviving a wildfire, and defensive actions could interact importantly with other resilience determinants. Consequently, a growing body of literature utilizes observational studies to highlight the various factors associated with structural survival.

Wildfire building codes largely pertain to a structure's external characteristics (e.g., exterior siding, windows, roof, etc.). The material used in exterior wall siding can affect whether or not a structure ignites when exposed directly to flames or intense radiant heat (Headwater Economics, 2018). Syphard et al. (2017) analyze the likelihood of structures surviving wildfires that ravaged San Diego County in 2003 and 2007, finding that stucco exterior outperforms masonry, metal, and wood variants. This performance, however, is likely driven by the fact that stucco-sided structures were generally built more recently in San Diego County, and new construction correlates with several other fire-resilience factors.

Syphard et al. (2017) dive deeper into these correlations by estimating a series of generalized linear multiple regression models to rank the relative importance of wildfire resilience factors, concluding that exterior construction material is the least important characteristic. Syphard and Keeley (2019) corroborate the irrelevance of exterior siding material in predicting structure survival when studying the universe of Southern California wildfires between 2013 and 2019. They find evidence, however, that exterior siding material may be more important in other regions, such as California's Bay Area.

In terms of external features of a structure, the literature considers window and roof characteristics to be more predictive of structural survival. Syphard et al. (2017) determine that roof material is more important than external siding, with tile-roofed structures more likely to survive wildfires than those with composite, metal, shake, and shingle varieties. In contrast, Syphard and Keeley (2019) rank the importance of roof material type below whether or not a structure's roof has enclosed or unenclosed eaves (or no eaves altogether). Unenclosed eaves offer a potential vulnerability to wind-blown embers.

Embers may also enter a structure through gaps in window seals. Intense flame or radiant heat exposure can melt window framing and break glass, serving as additional threats from wildfires. Syphard et al. (2017) estimate that window framing and the number of window panes are the most important structural characteristics in predicting survival during wildfires. Syphard and Keeley (2019) corroborate the importance of multi-pane windows in their general analysis across California wildfires.

In addition to structural characteristics, vegetation management is a common dimension that is regulated through wildfire building codes. Regulators may mandate a minimum "defensible space" between a structure and vegetation, serving as a buffer zone to reduce the ignitability of the area. For example, Chapter 7A of the California Building Code requires homeowners in Very High Fire Hazard Severity Zones to establish a defensible space of at least 100 feet around structures. Cohen (2000) and Cohen (2004) demonstrate that reducing up to 100 feet of vegetation around a structure can increase the probability of survival during a wildfire. Syphard et al. (2017) find evidence in support of this buffer zone, estimating that the distance of defensible space is roughly as important as window framing material in predicting structure survival. In contrast, Syphard and Keeley (2019) detect no evidence that the distance of defensible space generally explains structure survival. While the authors conclude that other factors are more important in determining structure survival, they acknowledge their limitations in measuring defensible space by horizontal distance. For example, their measure does not account for the presence of overhanging tree limbs or the aridity of the vegetation.

Biophysical features of a property also play an important role in determining structure survival. For example, properties characterized by high elevation or steep slopes may be more difficult to defend due to limited access for firefighting. Syphard et al. (2017) suggest that a property's percentage slope is less important than the slope percentage of the surrounding area, supporting the theoretical link behind firefighting access and slope. Similarly, they find a negative relationship between the likelihood of structure survival and the distance to major roads. Syphard and Keeley (2019) attempt to directly examine the importance of defensive action by firefighters, but they struggle to overcome missing data in their sample.

The importance of property-level characteristics in predicting structural survival is well established in the literature, but less is known about how the spatial pattern of development (e.g., structure density) impacts local resilience. Alexandre et al. (2016) suggest that topography and the spatial arrangement of buildings may be more important than vegetation-related factors in wildfires across the conterminous United States from 2000 to 2010. Syphard et al. (2012) investigated the spatial patterns of neighborhoods in the context of wildfires in the Santa Monica Mountains and San Diego County from 2001 to 2009. They determine that these patterns are even more important than biophysical variables (e.g., slope and elevation).[1] In particular, they estimate that property loss is more likely in smaller, isolated housing clusters characterized by low or intermediate density. The location of structures within a neighborhood also plays a significant role, with those situated near the edge of development being more susceptible to wildfires.

Baylis and Boomhower (2021) consider the bundle of these structure-specific characteristics through the lens of California's wildfire building codes. The authors provide evidence that state and local building codes are increasing the likelihood that structures survive wildfires. Not only do these mandates protect individual structures, but they also reduce the likelihood of destruction for neighboring properties (that may have pre-dated stricter regulation). The benefit is larger when homes have multiple neighbors in the vicinity.

[1] Syphard et al. (2012) are unable to observe structural characteristics (e.g., building material, structure age, etc.).

Data Sources

We collect and derive data mainly from four sources: the CAL FIRE Damage Inspection Program Damage Inspection (DINS) database, the LA County Assessor's Office, the Los Angeles Region Imagery Acquisition Consortium (LARIAC) Program, and OpenStreetMap. Additional information about the areas is sourced from Google Maps API, Spatial Analysis for Conservation and Sustainability (SILVIS) Lab at the University of Wisconsin-Madison, and the California Department of Forestry and Fire Protection. Our dataset represents all the structures assessed for damage by the CAL FIRE Damage Inspection Program in the aftermath of the January 2025 wildfires.

The CAL FIRE Damage Inspection Program (DINS) database provides data on the damage status of structures within the fire radius of the fires in the Palisades and Altadena. The data provides information on the structure's coordinates, damage status, and type (for example, "Multi-Family Residential", "Utility Structure"). We use the provided coordinates to link structures to their corresponding census tracts, census blocks, and parcels. Matching the points to parcels provides Assessor's Identification Numbers (AINs) for each structure, which is then used to match the structures to relevant parcel-level information, such as the property value and the parcel use type. Additional geospatial analysis provided information about each structure's proximity to other structures[2], the structure's presence in a fire hazard severity zone/wildland urban interface, and the distance to road networks and fire stations[3].

While the Assessor provides data at the parcel level in their open data portal, we need more structure-specific data for the purpose of this analysis. Additional data obtained via a personalized data request from the Assessor's office provides information about the year built and the effective year, the construction quality, and the building materials of each structure. This information was merged with our original DINS data using AINs, building type descriptions, and the documented year built[4]. Our team also merged data on the average parcel ground elevation, structure height/square footage, and the slope of each parcel from the Los Angeles Region Imagery Acquisition Consortium (LARIAC) Program. Finally, the team merged census block-level data of green coverage from the National Agriculture Imagery Program (NAIP) in Google Earth Engine.

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[2] Proximity to other structures is calculated by creating 25 meter buffers around coordinates and counting the number of structures within the created buffers. Since coordinates of structures are provided by the DINS damage assessment, points are not necessarily reflective of the structure's exact centroid or building footprint. This point is a proxy for structure density, rather than an exact measure.

[3] Road networks are extracted from OpenStreetMap, and fire stations are extracted from the Google Maps API. Distance is calculated in both Euclidean distance and network distance.

[4] Some structures remain unmatched, due to either the destroyed structure being a minor improvement or accessory structure (such as a fence or garage), or the Assessor building records not being updated with new construction.

In order to create variables to be included in our regression analysis, the following data points are transformed into binary indicators:

- Presence in a fire hazard severity zone/wildland urban interface (Yes or No)
- Year Built/Effective Year Built (Pre-2008 without any improvements, Pre-2008 with post-2008 improvements, Post-2008)
- Fireproof material (Class A/Class B or Not Class A/Class B)

Descriptive Summary Statistics

The Eaton and Palisades fires are among the most destructive in California's history. Table 1 provides some basic information on structural damage. The CAL FIRE DINS program assesses damage based on the estimated percentage of structure destroyed. Per these assessments, 51.3% of all structures were destroyed in the Eaton Fire, and 56.7% were destroyed in the Palisades Fire. A relatively small number of structures suffered minor or major damage; most of the building stock either experienced no damage or was completely destroyed.

Table 1: Property damage, Eaton and Palisades fires

	Eaton Fire		**Palisades Fire**	
	Number of properties	**Percent of total properties**	**Number of properties**	**Percent of total properties**
Total properties	18,364		12,081	
No damage	7,886	42.94%	4,262	35.28%
Affected (1 - 9%)	849	4.62%	732	6.06%
Minor (10 – 25%)	148	0.81%	171	1.42%
Major (26 – 50%)	70	0.38%	71	0.59%
Destroyed (>50%)	9,411	51.25%	6,845	56.66%

Figures 1 and 2 map the fire damage. Each dot represents a structure. Green dots indicate no damage, and brown dots indicate a destroyed structure. Other colors indicate partial damage. In the Eaton Fire, damage is concentrated in the northwestern area, with fewer destroyed structures moving from northwest to southeast. Damage is less frequent along the southern edges of the fire, likely reflecting both the wind direction and firefighting efforts. The Palisades Fire damage is concentrated in the Pacific Palisades community, but is also dispersed along the Malibu coastline and canyon areas. Figures 1 and 2 demonstrate the geographic extent of the fires. They indicate an enormous logistical challenge in fighting a fire of such extent.

Figure 1: Map of Eaton Fire structures, by damage status

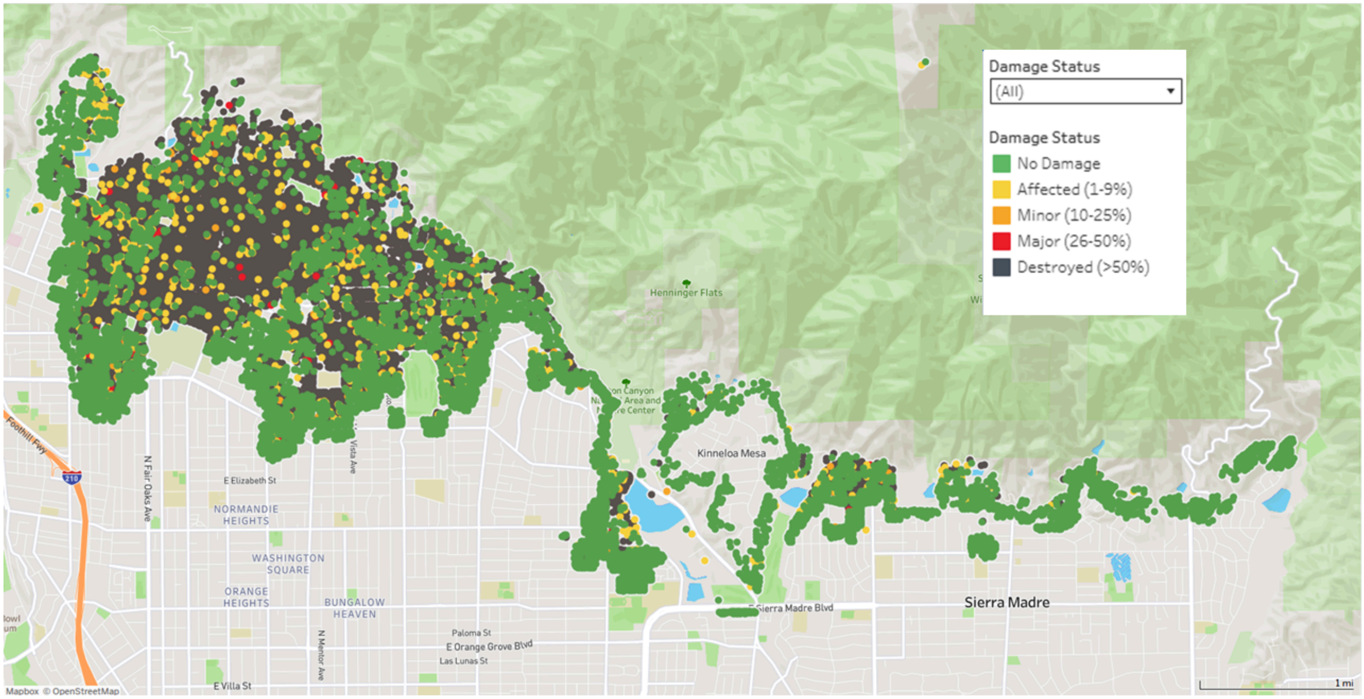
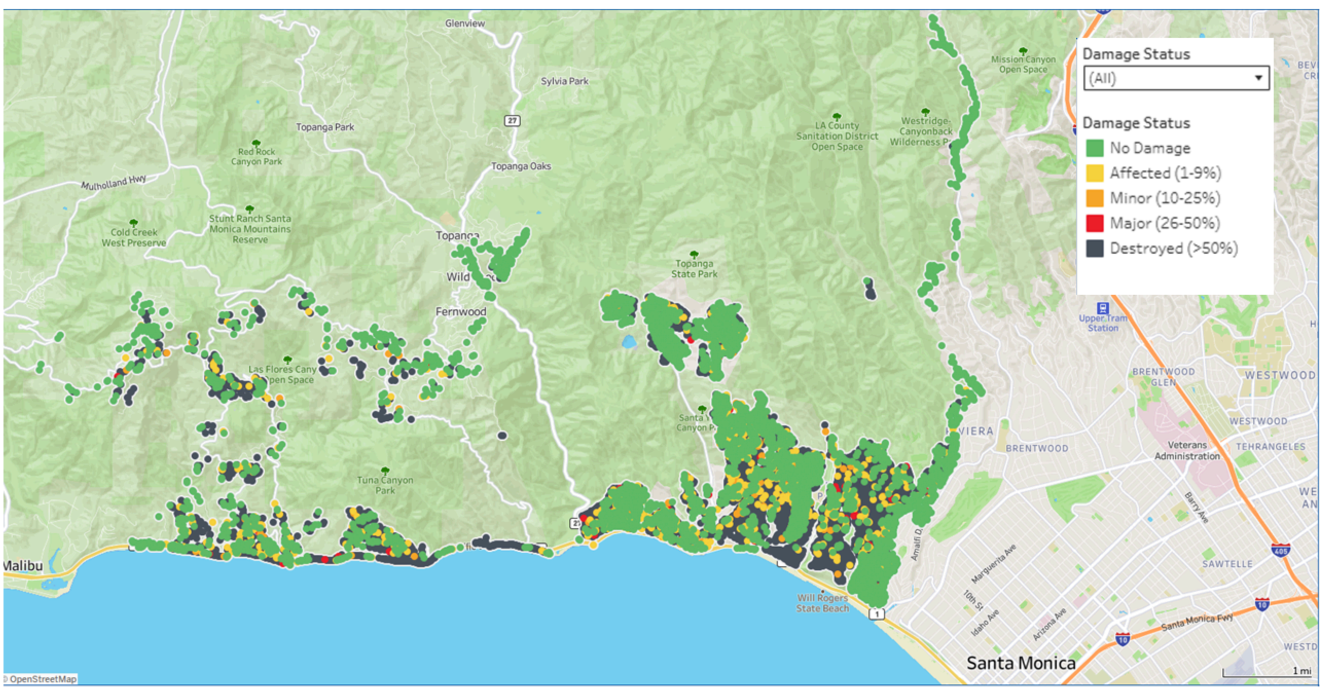


Figure 2: Map of Palisades Fire structures, by damage status



Our interest is in examining whether building regulations, and the 2008 building code changes specifically, made a difference in structure fire survival. A first-level comparison is given in Table 2. We divided structures into three categories: whether built before 2008, those built before 2008 but renovated under the 2008 code, and those built after 2008. There is a distinct trend: a greater share of post-2008 structures survived with no damage, and a smaller share was destroyed in both Eaton and Palisades, providing some evidence that the 2008 code changes had a positive effect. However, the vast majority of the housing stock in these areas was built before 2008 (see the bottom line of the table), and in the Palisades, half of the post-2008 construction was lost. We conducted a simple difference in group test and found that in Eaton Canyon, houses built after 2008 were statistically less likely to be destroyed (t-value of 4.29, $p < .0001$). However, there was no statistically significant difference in the Palisades (t-value of 0.49).

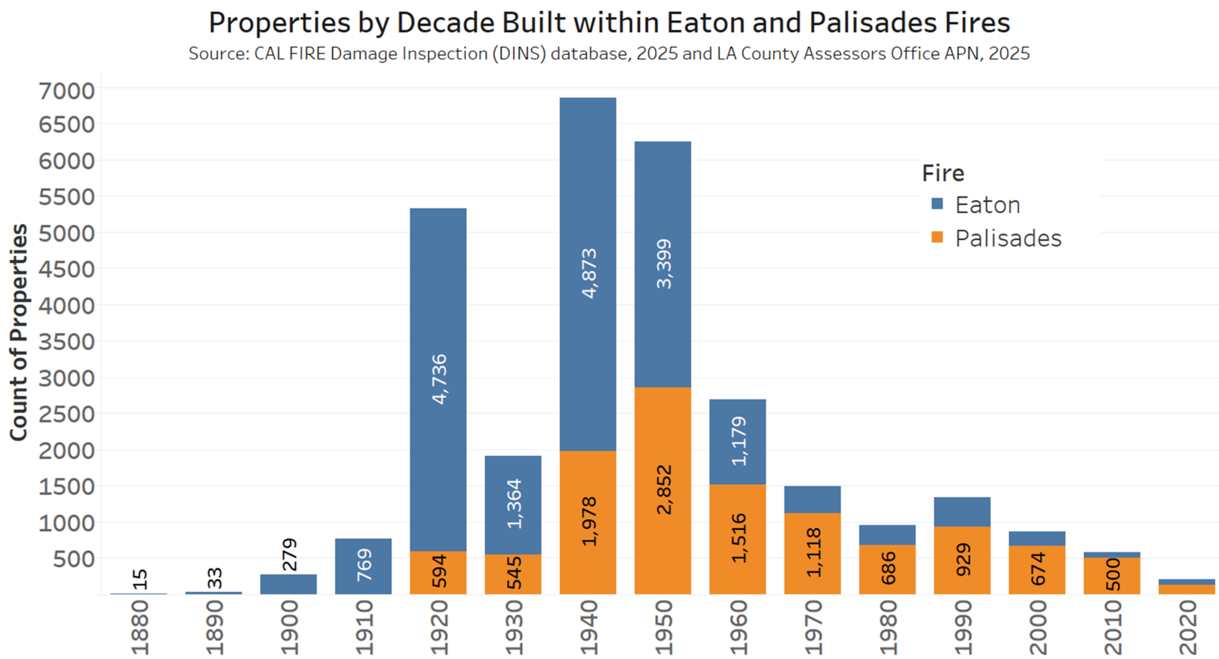
Table 2: Pre and post 2008 fire damage outcomes, percentages

	Eaton			**Palisades**		
	Pre-2008	**Pre-2008, recent improvements**	**Post-2008**	**Pre-2008**	**Pre-2008, recent improvements**	**Post-2008**
No damage	42.45%	40.20%	60.99%	34.62%	36.47%	40.85%
Affected	4.56%	6.86%	6.53%	6.04%	7.06%	6.18%
Minor	0.81%	0.98%	0.79%	1.41%	1.18%	1.44%
Major	0.34%	0.00%	1.78%	0.55%	1.18%	0.88%
Destroyed	51.85%	51.96%	29.90%	57.38%	54.12%	50.64%
Total Count	17757	102	505	10750	85	1246

Our literature review indicates that many factors are important in structure fire resilience, including construction materials, window and roof configurations, surrounding vegetation, spatial patterns of neighborhoods, and topography. We consider structure age as a proxy for several of these factors. The earliest Eaton Fire area housing stock was built at the turn of the 20th century, typically featuring wood-frame Victorian homes, soon followed by the classic wood-frame California bungalow style. The 1930s introduced Spanish and other vernacular styles, typically constructed with wood and plaster. Stucco became ubiquitous in the postwar era. Garages moved from detached to attached, changing the spatial configuration of structures. In addition, development typically begins in areas where building construction is easier – such as flat areas that can be developed in a grid pattern. As demand for housing increases, development expands at the edge of the urban interface, possibly into more hilly terrain, and pushes settlement into more fire-vulnerable areas.

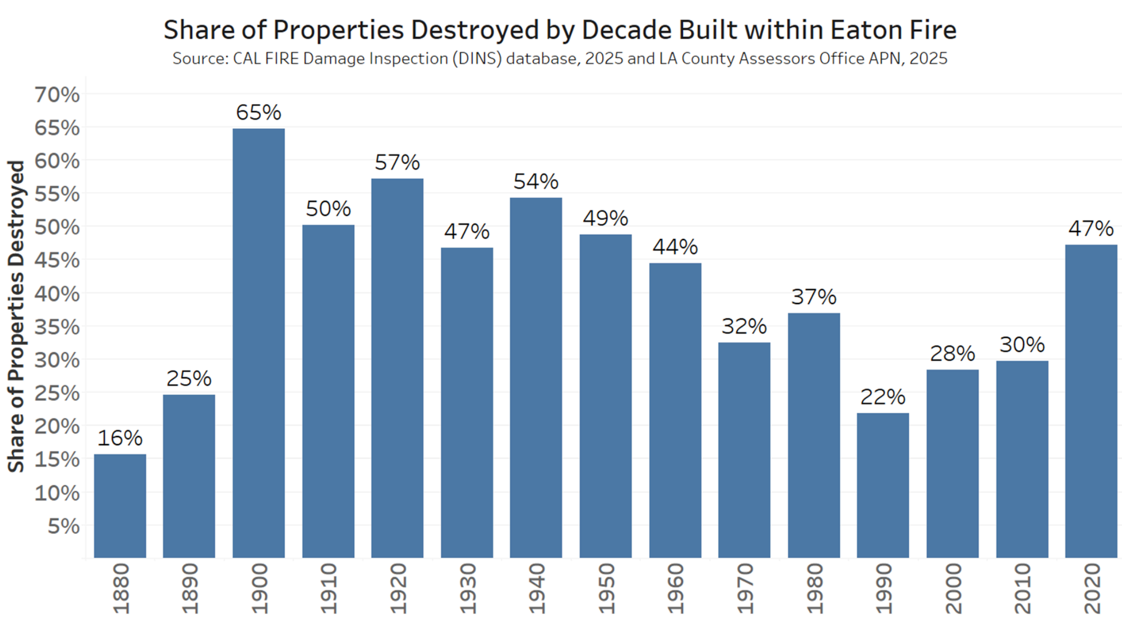
Figure 3 shows building stock by decade built for the Eaton and Palisades fire areas. It can be seen that Eaton housing stock is much older, with most built in the 1920s - 1950s. Although the 1950s were the decade of the most growth for Palisades, substantial numbers have been added in every decade since.

Figure 3: Total properties built by decade, Eaton and Palisades areas



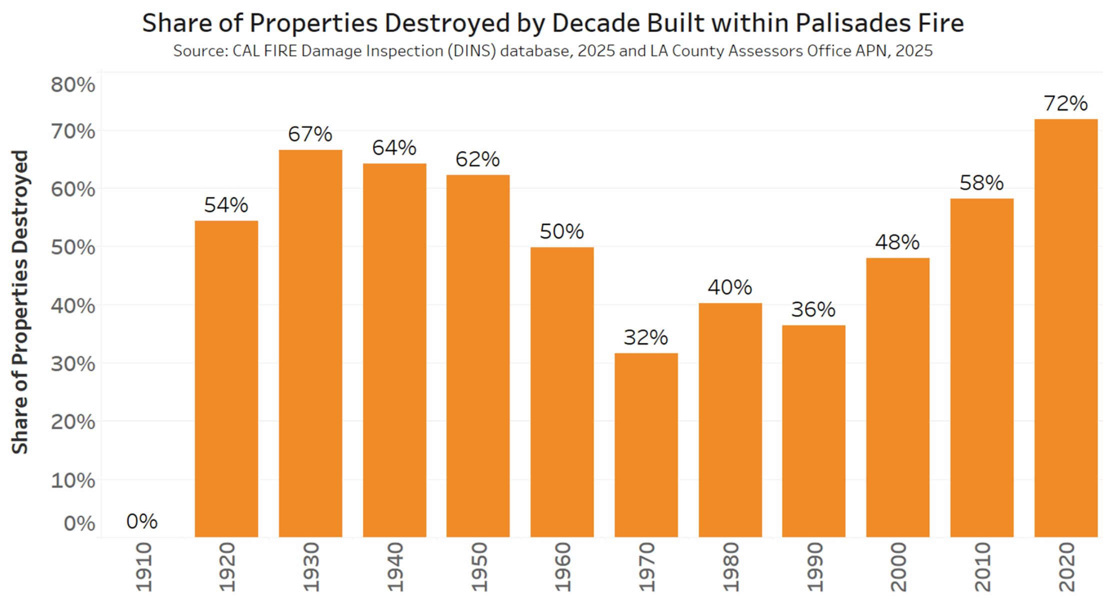
Figures 4 and 5 give fire outcomes by property vintage for the Eaton and Palisades fire areas, respectively. For the Eaton Fire, among the pre-1920 structures, those from the 1880s fared the best, and those from the 1900s fared the worst, perhaps reflecting different neighborhood locations with respect to the path of the fire. Post-1960s properties tended to fare better, except for the most recent buildings from the 2020s.

Figure 4: Share of properties destroyed by construction vintage, Eaton fire



In contrast, the structures in the Palisades Fire of the 2010s and 2020s were destroyed at a rate surpassed only by those of the 1930s through 1950s vintages. Thus, the structure's age and all it represents do not explain fire survival.

Figure 5: Share of properties destroyed by construction vintage, Palisades fire



Urban fires spread by moving from one structure to another. It seems logical that if structures are close to one another, it is easier for the fire to spread. For each property, we calculated the number of structures within a 25-meter radius from the centroid of the given property. We then compared the level of damage to the proximity to other structures. Results are given in Figures 6 and 7 for Eaton and Palisades, respectively. There is a clear trend: in both cases, properties that were more isolated (had no other structures within a 25-meter radius) were less likely to be damaged, and properties with six or more structures within 25 meters were much more likely to be damaged. The trend is particularly strong for the Palisades fire. The effect of proximity will be further discussed in the next section.

Figure 6: Structure proximity and damage level, Eaton Fire area

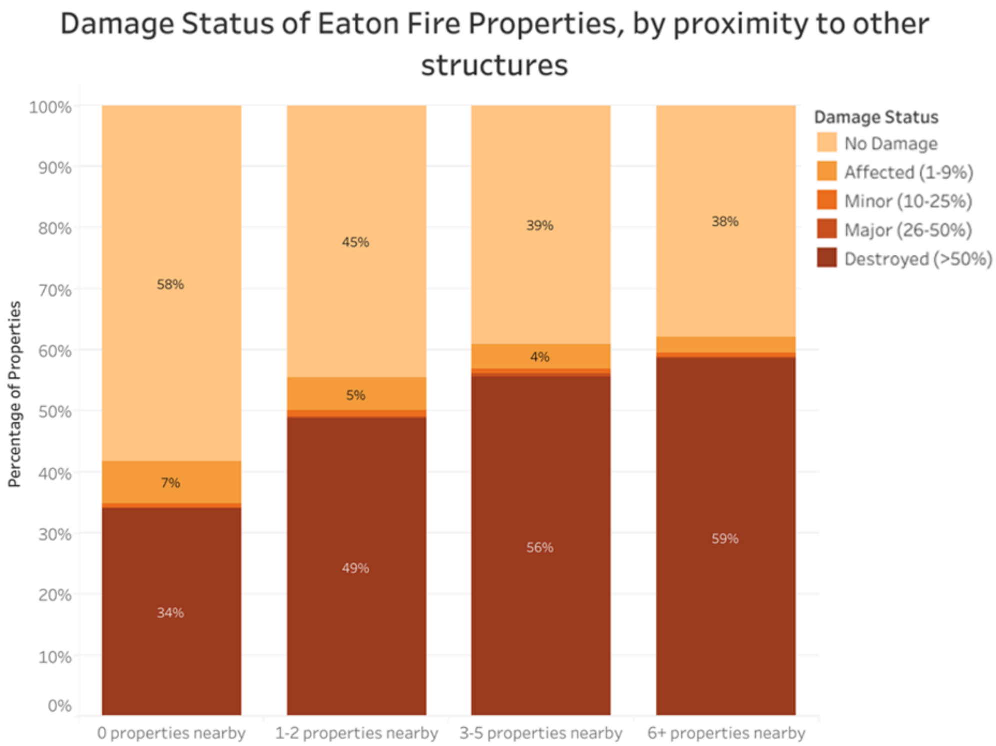
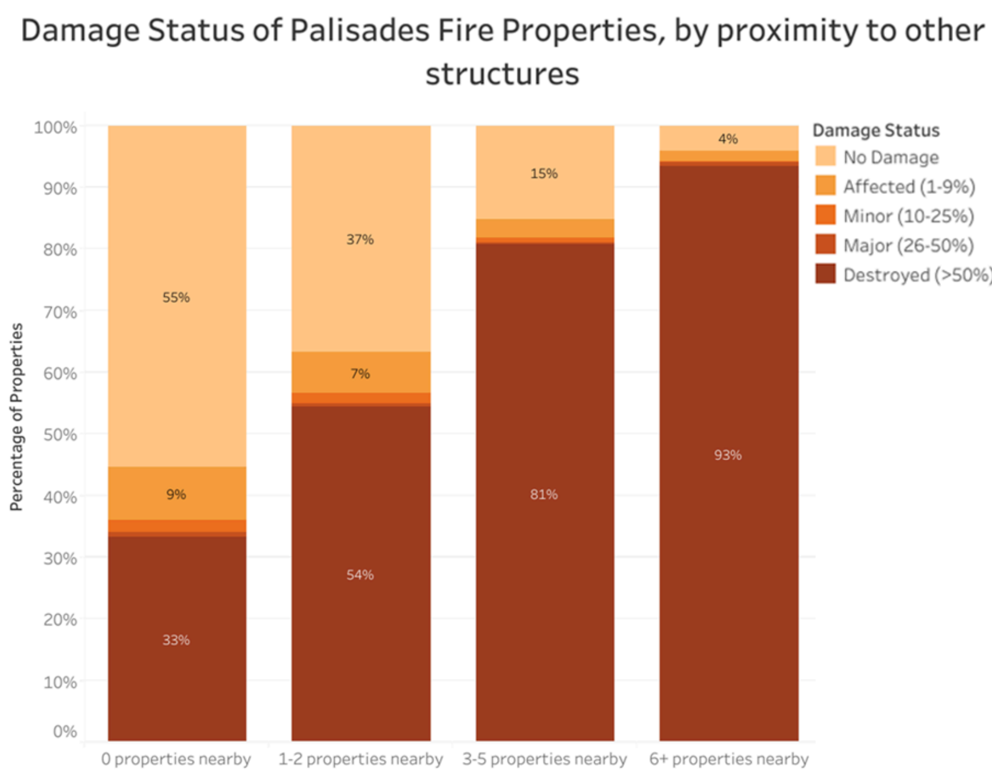


Figure 7: Structure proximity and damage level, Palisades Fire area



Analysis and Findings

We begin by documenting the association between vintage and construction quality. This link is important because we are investigating whether changes to California building codes have reduced the probability of fire destruction, and the mechanism for such a connection would be the quality of construction.

The Los Angeles County Assessor assigns scores to properties based on construction quality; we provide the definitions of each score in an online appendix. The regression we perform is simple; we fit the equation:

$$CQ_i = \alpha + \beta_1 Post92_i + \beta_2 Post08_i + \varepsilon_i$$

where *Post92* and *Post08* represent a property constructed after the 1992 and 2008 state regulations respectively. We then perform ordinary least squares regressions to examine the association between the propensity for a house to be destroyed and the quality of construction, as defined by the Los Angeles County Assessor. We limit our analysis to residential buildings, including both multifamily and single-family properties.

Table 3 demonstrates the association between building quality and major code year. Note that properties built in the Palisades were of higher quality after the institution of the 1992 building code, and then even more so after the institution of the 2008 building code. In Eaton Canyon, however, while quality improved after the 1992 code, it actually *fell* (relative to 1992) after the 2008 code. This surprises us, and may reflect spuriousness arising from data scarcity. Very little was built in Eaton Canyon after 2008.

Table 3: Construction, Vintage, and House Quality

Dependent variable: CQ

Variable	Palisades	Eaton Canyon
post_1992	1.594***	2.539***
	(0.044)	(0.051)
post_2008	1.569***	-1.403***
	(0.067)	(0.107)
Constant	8.41***	6.357***
	(0.016)	(0.01)
N	9104	11898
r2_a	0.317	0.176

*Coefficients reflect the association between whether a property was built after the 1992 and 2008 California building code revisions and the Los Angeles Assessor's judgment of construction quality. Standard errors in parentheses. * p<0.10, ** p<0.05, *** p<0.01.*

Figures 8 and 9 show the relationship graphically. Each figure gives the share of total units by construction quality for properties built before and after 2008, for Eaton and Palisades respectively. For the Eaton fire area, construction quality is only slightly higher for post 2008 properties. For the Palisades fire area, construction quality is clearly higher for post 2008 properties.

<u>Figure 8: Distribution of Housing Quality for Eaton properties, split by vintage pre- and post-2008 code</u>

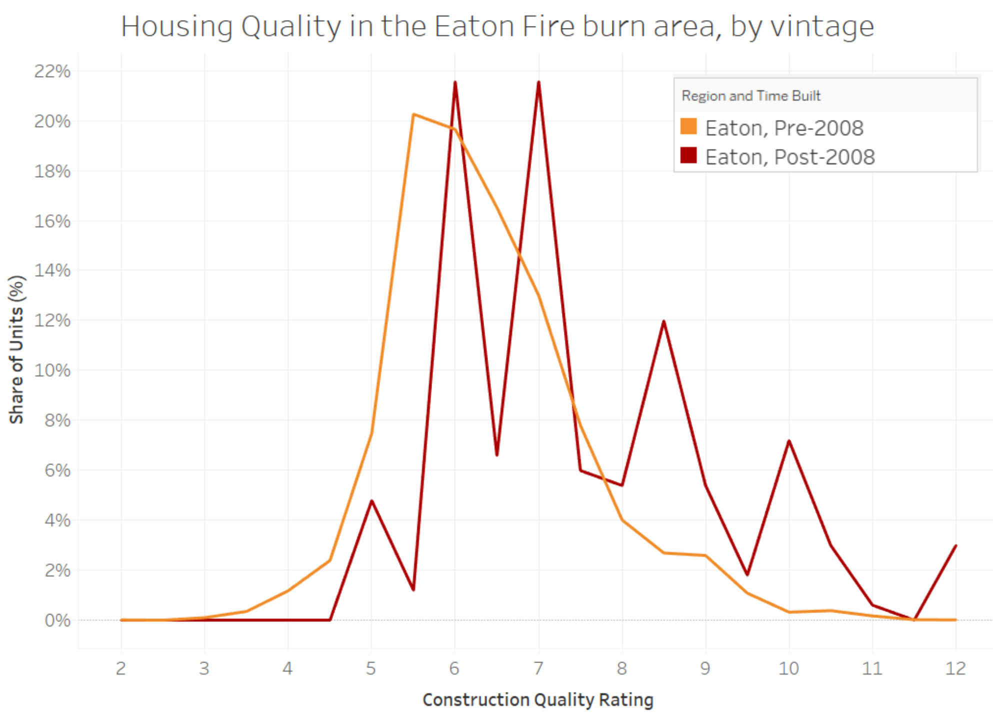
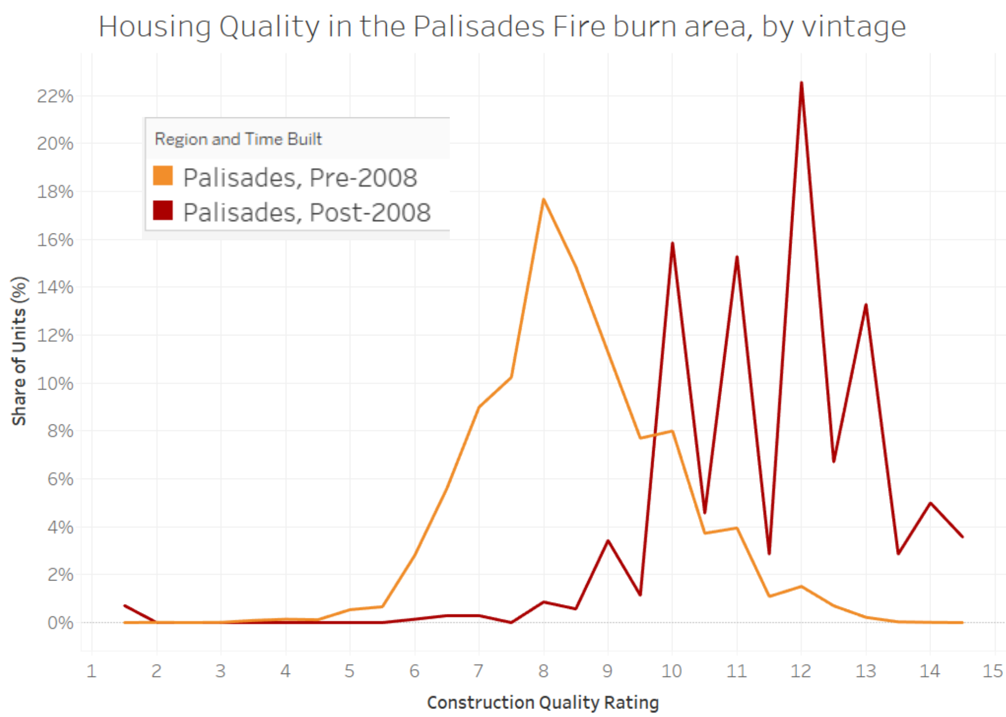


Figure 9: Distribution of Housing Quality for Palisades properties, split by vintage pre- and post-2008 code



We next turn to our featured regression, which tests our hypothesis of whether changes in building codes improved survival outcomes for houses. The regression controls for the impact of natural factors, the built environment, and location, before considering whether vintage affected the probability of surviving a fire. The natural factors include distance from the fire's origin, as well as latitude and longitude, which represent the fire's path. Moreover, because we have census tract dummy variables, we can characterize fire paths after controlling for local features that are not measured by our other variables. We also have a variable representing slope, because houses on steep slopes may have a greater propensity to burn and may be more difficult for firefighters to reach.

For the built environment, we have variables representing both within-building density and building density at a distance. As we shall see, this distinction is important. We tried a variety of specifications incorporating building vintage and building quality. In the end, we find the most explanatory power comes from regressions that control for post-1992 and 2008 vintages (i.e., houses built after the implementation of important building codes) and for houses with quality scores above 8.5. We also have a variable representing ground cover, but it is only available at the census tract level. Tables 4 and 5 give descriptive statistics for the Eaton and Palisades fire areas respectively.

Table 4: Eaton Descriptive Statistics

Variable	Mean	Median	Std. Dev	Minimum	Maximum
Latitude	34.189	34.191	.011	34.161	34.232
Longitude	-118.128	-118.135	.029	.029	-118.018
# of structures within 25 meters	4.019	4.000	1.953	1.000	13.000
Construction Quality	6.396	6.000	1.165	2.000	12.000
Flag for construction 2008 or later	.028	0	.164	0	1
Euclidean distance from fire origin	4301.923	4306.643	1703.440	44.611	9343.215
Average Parcel Slope	7.321	6.423	4.559	1.712	41.718
Green Coverage (%)	.331	.334	.097	.026	.884
Structure Square Footage	2008.787	1694.934	2947.294	13.064	84703.52
post_1992	0.0638	0	0.244	0	1

N = 18,402

Table 5: Palisades Descriptive Statistics

Variable	Mean	Median	Std. Dev	Minimum	Maximum
Latitude	34.051	34.047	.0139	34.030	34.129
Longitude	-118.554	-118.542	.040	-118.686	-118.499
# of structures within 25 meters	2.922	3	1.808	1	14
Construction Quality	8.685	8.5	1.644	0	14.5
Flag for construction 2008 or later	.103	0	.304	0	1
Euclidean distance from fire origin	3399.513	1987.507	3202.917	19.259	14566.18
Average Parcel Slope	13.407	11.912	7.096	1.902	41.170
Green Coverage (%)	.263	.236	.127	.002	.864
Structure Square Footage	2967.846	2640.188	3780.232	63.083	111728.9
post_1992	0.178	0	0.382	0	1

N = 12,081

The results are in Table 6 below. We estimate four models, including Palisades and Eaton, each with and without the high-quality index variable. Houses with missing quality index variables are assumed to be of low quality.

Table 6: Survival outcomes

Dependent variable: Whether the structure was destroyed

Variable	Eaton		Palisades	
Latitude	4.734*** (1.18)	4.241*** (1.166)	-3.272*** (0.669)	-2.964*** (0.644)
Longitude	-8.934*** (0.793)	-9.186*** (0.782)	-7.259*** (0.859)	-7.875*** (0.819)
within_25m_count	0.022*** (0.003)	0.024*** (0.003)	0.078*** (0.004)	0.079*** (0.004)
High Quality Construction		0.04* (0.021)		-0.027** (0.012)
post_1992	-0.299*** (0.025)	-0.371*** (0.021)	-0.06*** (0.015)	-0.072*** (0.015)
post_2008	0.25*** (0.041)	0.283*** (0.037)	0.064** (0.025)	0 (0.02)
Distance from Fire Origin	0 (0.001)	0 (0.001)	-0.007*** (0.001)	-0.008*** (0.001)
Average Slope	0.027*** (0.001)	0.028*** (0.001)	0.013*** (0.001)	0.012*** (0.001)
Tract Green Coverage	-0.114** (0.05)	-0.124** (0.049)	-0.154*** (0.053)	-0.164*** (0.052)
Single Family Residence Multi Story	-0.09*** (0.01)	-0.101*** (0.01)	-0.087*** (0.01)	-0.087*** (0.01)
Multi Family Residence Single Story	-0.163*** (0.039)	-0.147*** (0.036)	-0.212** (0.096	-0.151* (0.086)
Multi Family Residence Multi Story	-0.029 (0.032)	-0.014 (0.03)	-0.300*** (00.029)	-0.267*** (0.025)
Floor Space of Structure	0 (0)	0 (0)	0 (0)	0 (0)
N	11832	12084	9099	9504
R2 adj	0.383	0.378	0.298	0.295

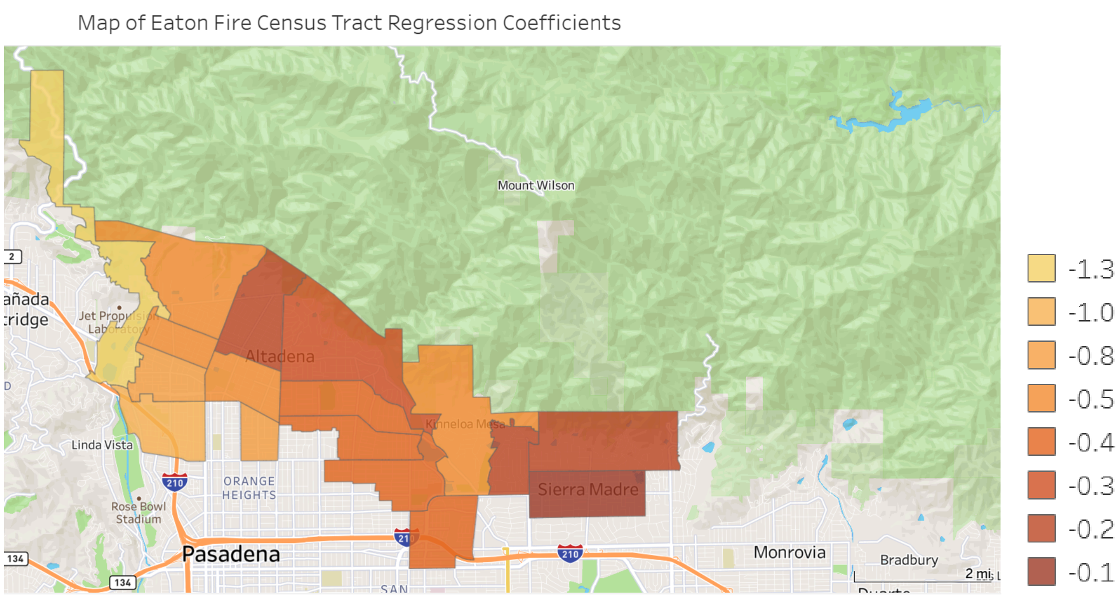
*Standard errors in parentheses. * p<0.10, ** p<0.05, *** p<0.01.*

Note: All models include census tract fixed effects. Missing values are counted as low-quality construction.

While the results for the two devastated areas share many similarities, they also exhibit some differences. We begin with latitude and longitude. Both matter in both places, but in different directions. In the Palisades, the higher the latitude (i.e., the farther north a location is), the less likely a house was to be destroyed. In Eaton Canyon, places farther north were more likely to be destroyed. Longitudes west of the prime meridian are negative numbers, so a negative coefficient means that places in the west burned more than places in the east. The coefficients on longitude are negative and highly significant in both areas. Note that these latitude and longitude variables are significant after controlling for census tract dummy variables, meaning that within each census tract, the western portion was more likely to have destruction than the eastern portion, and that the southern portion in the Palisades and the northern portion in Eaton Canyon were more likely to have destruction.

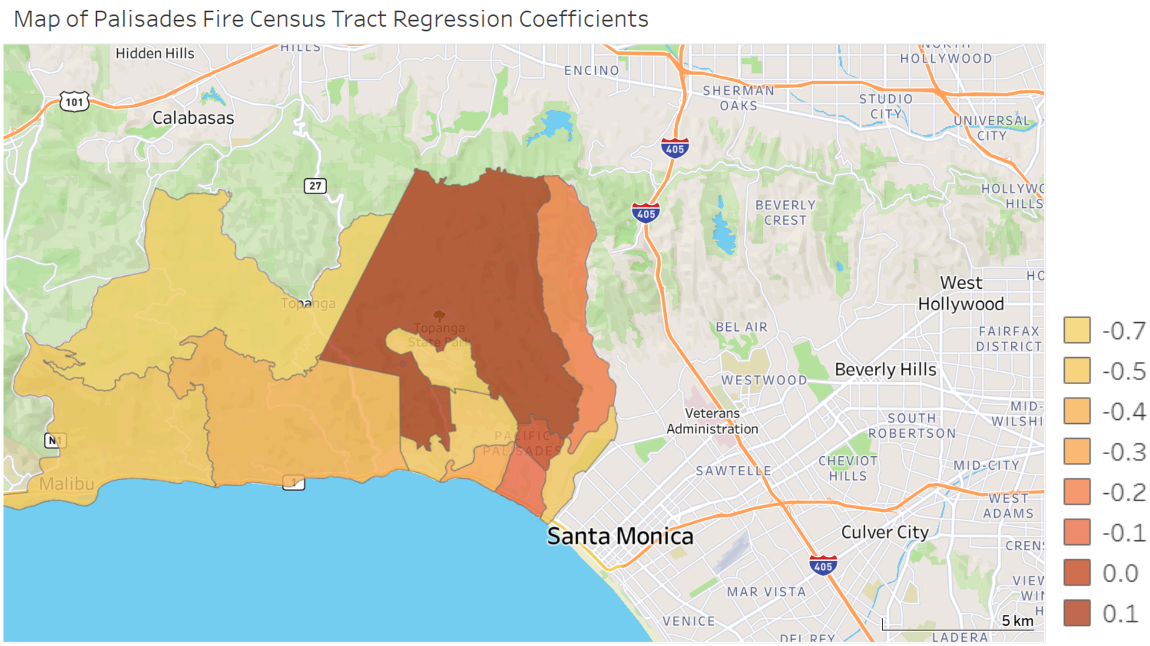
We note that even after controlling for a rich set of characteristics, some places were more susceptible to burn than others. Figures 10 and 11 indicate propensity for destruction by census tract in the two areas. Places on hillsides had a greater tendency to be destroyed, even after controlling for measured characteristics such as slope and ground cover.

<u>Figure 10: Eaton census tract coefficients</u>



Darker colors represent coefficients of higher values.

Figure 11: Palisades census tract coefficients



Darker colors represent coefficients of higher values.

Finally, distance to the fire origin has an impact on the likelihood of destruction for the Palisades, even after controlling for census tract, latitude, and longitude. There is no such association for Eaton Canyon.

We now turn to the physical characteristics of the houses. First, we find that *building density* is a strong predictor of destruction. This result could mean that outbuildings (likely within 25 meters of a main building) help spread the fires. On the other hand, as buildings grew larger, the likelihood of being destroyed decreased. Two-story single-family houses were less likely to be destroyed, and multifamily properties were less likely to be destroyed than single-family properties. The floor space of the structure had no impact.

When we examine the impact of the physical characteristics of lots, we see that slope mattered—places with more severe slopes were more likely to be destroyed. On the other hand, the variable on ground cover has the opposite sign from what we expected, perhaps reflecting the fact that we were unable to measure at the individual parcel level.

Most interesting to us is that after controlling for these building characteristics, we find that the 1992 codes were associated with a substantial reduction in burn, even after controlling for building quality. This result may indicate that the code required important fire-resistant features that were not apparent to the assessor when rating the building's quality.

Conclusion

In this report, we documented the breadth of destruction arising from the fires of early January 2025 in the Pacific Palisades and Altadana (Eaton Canyon). We have shown bilateral correlations between a number of features and the likelihood of destruction; demonstrated that houses built after the 1992 California code reforms were built to a higher quality than houses built before those reforms, and that houses built in both Altadena and the Palisades were less likely to burn down if they were built after 1992. This reduced propensity to burn survives even after controlling for measured quality, which itself is influenced by whether a house was built after 1992. Curiously, however, the 2008 codes do not seem to improve survival rates; in fact, in Altadena, it seemed to claw back some of the benefits of the 1992 code. This may simply reflect a spurious result arising from a small sample.

Our results have other policy implications. For example, we find that building density amplifies burning, but dense buildings do not. Buildings in close proximity to others were more likely to catch fire, but larger buildings were less likely to burn. Multifamily buildings survived better than single-family buildings, and two-story buildings survived better than one-story buildings. Steeper slopes also appear to have led to a greater propensity to burn.

Perhaps most importantly, we find that the building code changes of 1992 had a marked impact on the likelihood that a house would survive; we do not have sufficient data to draw inferences about the 2008 code. However, we do have evidence that policy matters in preventing devastation from fires.

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