DEPARTMENT OF LABOR AND INDUSTRY

Meeting Notes: Single Exit Stairway Apartments Technical Advisory Group

Date: Thursday, June 26, 2025
Time: 9:00 a.m.
Location: DLI, 443 Lafayette Rd. N., St. Paul, MN 55155 / WebEx

Members

1. Mary Barnett
2. Tom Brace
3. Nathan Bruhn
4. Nick Erickson
5. Patrick Farrens
6. Stephen Kartak
7. Greg Metz (Coordinator, DLI)
8. Jerry Norman
9. Tom Pitschneider
10. Ryan Rehn (Coordinator, DLI)
11. Melisa Rodriquez
12. Stephen Smith (WebEx)
13. Amanda Swenson

Members Absent

Adam Casillas
Jim Fischer
David Selinsky

WJE/Crux Consultants

Carl Baldassarra – Wiss, Janney, Elstner Assoc. (WJE)
Kyle Christiansen – Crux Consulting
Brian Meacham – Crux Consulting (WebEx)
Nick Ozog – WJE

Staff & Visitors

Ken McGurran – Atty for CCAC, DLI
Lyndy Logan – DLI
Mike Bunnell – DLI (WebEx)
Britt McAdamis – DLI
Chad Payment – DLI (WebEx)
Wendy Rannenberg – DLI (WebEx)
Don Sivigny – DLI
Amanda Spuckler – DLI
Eric Zercher – DLI (WebEx)
Sarah Carter – ICC (WebEx)
Kim Clawson – WJE (WebEx)
Ervin Cui – WJE (WebEx)
Dori Dufresne – U of M (WebEx)
Richard Hauffe – ICC (WebEx)
Tom Jenson – SFMD
Ed Lisinski – AWC (WebEx)
Chris Machmer – City of Duluth (WebEx)
Michael Mintle – EIWPF (WebEx)
Robert Nelson – Local 9
Jon Nisja – NFSA
Ryan Parkos – Local 9 (WebEx)
Seva Rodnyansky – Pew Trusts (WebEx)
William Skudlarek (WebEx)
Kevin Sullivan – EIWPF (WebEx)
Clayton Talbot – U of M (WebEx)
Nate Voye – City of Burnsville (WebEx)
Kate Wagner – MNFAC/LGN
Forrest Williams – DPS (WebEx)

Instruction/Procedures

- The meeting was called to order at 9:02 a.m., with 13 members present in person or remotely. A quorum was maintained throughout the meeting.
- WebEx Instructions/Procedures
  - **TAG members:** TAG members attending online may mute and unmute their microphones to participate openly and actively as if they are attending in the room. You can also click the hand icon to be recognized if you find it difficult to get into the conversation.
  - **Interested parties/members of the public:** As the Technical Advisory Group is a legislatively mandated body tasked with providing insights for a legislative safety study and is not directly involved in rulemaking, members of the public are welcome to attend and listen to the meeting but will not be allowed to participate.

Agenda Items

Introduction – DLI
Call to Order and Rules of Business

- **TAG Attendance**
- **Review the formation and purpose of the TAG – Greg Metz (DLI)**
  - **Greg Metz** explained that the Technical Advisory Group (TAG) was established by legislative mandate to support a fire safety risk assessment study focused on single exit stairway apartment buildings up to 75 feet in height. He noted that the study is funded by the 2023 legislative session. Metz emphasized that TAG members were appointed to represent specific stakeholder groups and are expected to share the perspectives of those groups, not just personal opinions. He clarified that the TAG does not have rulemaking authority; its role is to advise and inform the study. **The final report is due to the legislature by December 31, 2025**, and any decision to proceed with rulemaking will be made by the legislature—not by the Department of Labor and Industry (DLI) or the Construction Codes and Licensing Division (CCLD).
- **Administrative Procedures Act and open meeting law**
- **Procedures for participation**
  - This is a public meeting, and the public is welcome to observe both in person and online. However, online chat functions are disabled to maintain the structure of the discussion.

DLI Objectives for the TAG Mtg #2

- Consensus agreement from TAG on baseline model to be used as the code-compliant basis of comparison of fire safety risk
- Consensus agreement from TAG on a reasonable format for the baseline fire study model (general description of floor plan configuration)
- Consensus agreement from TAG on a prioritized list of variations to the fire study model that will be studied to determine effects on fire safety risk
- Consensus agreement from TAG on safety feature overlays or modifications to be modeled for risk assessment comparison and determining the efficacy of safety measures
  - Greg Metz outlined the key objectives of the study: to compare current code-compliant designs with a proposed model that includes failure scenarios and additional safety features. He emphasized the need for the TAG to reach consensus on a code-compliant baseline, which will serve as the reference point for risk assessment and be assigned a comparative risk value. Metz also noted that the group must agree on a specific study model to be used in the FHIR software, selecting building configurations such as height, number of stories, and units per story, given limited legislative funding.
  - Metz stated that the group would also review variations and potential safety feature modifications to be included in the modeling. The goal of the meeting was to establish a shared understanding of both the baseline and the FHIR model. He added that meeting notes would be compiled and shared with the consultant team to begin drafting the report.

Recap and Update Since Last TAG Mtg (WJE/Crux)
Summary Update

Kyle Christensen summarized their presentation – see **Attachment A**

Review of Modeling Information (WJE/Crux)

Nick Ozog continued the presentation (see **Attachment A**) and facilitated the discussion to select fire scenario modeling parameters, including square footage, number of stories, number of dwelling units per floor, and stair width.

- **Fire Study Model Parameters**
  - 8 total levels: 7 stories above grade + 1 basement
  - 6,000 sq ft per floor with 8 dwelling units
  - 48-inch stair width and elevator included
  - R-2 residential occupancy; construction type not specified but assumed code-compliant
- **Fire Modeling Assumptions**
  - Fire is assumed to have already started
  - Sprinkler system modeled as ineffective to simulate the worst-case
  - Scenarios include:
    - Dwelling unit fire with door open
    - Corridor fire with stair doors in various positions
  - Focus: smoke spread and tenability for occupants outside the fire origin
- **Study Purpose & Strategy**
  - Assess relative fire risk, not determine absolute safety
  - Sensitivity analysis planned (e.g., 4,000–5,000 sq ft models) to evaluate risk thresholds
  - Results will inform, not dictate, future rulemaking
- **Market & Design Considerations**
  - 6,000 sq ft floor plate aligns with developer goals (50–60 units total)
  - Flexibility in unit count and size supports feasibility
  - Elevator and corridor width chosen for practicality and marketability
- **Rulemaking Implications**
  - Study supports “missing middle” housing goals
  - Rulemaking may impose stricter requirements than modeled
  - Model excludes mixed-use and basement units unless explicitly stated

Conclusions (DLI)

Greg Metz expressed appreciation to the consultant team for their preparation for the Technical Advisory Group meeting and clarified that, while the model will not specify a construction type, it will comply with the State Building Code for all unspecified elements.

The meeting adjourned at 11:36 AM.

Respectfully submitted,
Lyndy Logan
Executive Secretary, CCAC

Single Egress Stairway Apartment Building Study

TAG Meeting No. 2| June 26, 2025

DEPARTMENT OF LABOR AND INDUSTRY

dli.mn.gov

DEPARTMENT OF LABOR AND INDUSTRY

Welcome

Nicholas Ozog | Associate Principal - Wiss, Janney, Elstner Associates, Inc.

Kyle Christiansen | Consultant – Crux Consulting

Carl Baldassarra | Senior Principal - Wiss, Janney, Elstner Associates, Inc.

Agenda – TAG Meeting No. 2

9:00 – 9:30 a.m.	Introduction - DLI
9:30 – 9:45 a.m.	Recap and Update Since Last TAG Mtg
9:45 – 10:45 a.m.	Review of Findings to Date
10:45 – 11:30 a.m.	Review of Modeling Information
11:30 a.m. – 12:00 p.m.	Conclusions - DLI

DEPARTMENT OF LABOR AND INDUSTRY

Recap and Update Since Last TAG Meeting

Nicholas Ozog | Wiss, Janney, Elstner Associates, Inc.

Plan from TAG Meeting No. 1

- [x] Interviews with TAG members
- [x] Collect data, papers, reports and perform literature review
- [x] Define fire scenarios
- [x] Investigate reliability and operability of mitigating systems
- [x] Model geometry
- [ ] Modeling
- [ ] Analysis
- [ ] Reporting

Objectives for TAG Meeting No. 2

- Recap the risk-informed approach
- Interview takeaways
- Insights from national and Minnesota data
  - Civilian fatalities, firefighter injuries
  - Fire scenarios
  - Equipment reliability
- Model geometries

Future Work After TAG Meeting No. 2

- Evaluate feedback received from TAG #2
- Finalize floor geometries
- Probability data for mitigating equipment
- Event tree / fault tree structure logic and quantification
- Modeling: fire, smoke, egress
- Draft report

DEPARTMENT OF LABOR AND INDUSTRY

Summary of Risk-Informed Approach

Kyle Christiansen | Crux Consulting

Risk-Informed Approach

- Review data, literature
- Identify systems that mitigate consequences
- Assign probabilities of success / failure for each system
- Calculate the likelihood of each end state occurring
- Define and model fire scenarios to evaluate the consequence
- Perform comparative risk assessment for model geometries
- Understand the risk-significant mitigating systems

DEPARTMENT OF LABOR AND INDUSTRY

Review of Findings to Date
TAG Interview Summary

Nicholas Ozog | Wiss, Janney, Elstner Associates, Inc.

TAG Interview Summary

- Thank you!
- Significant input and efforts from the group
- Representation from all the general sub-groups
- Not too late – Reach out to us

TAG Interview Summary

TAG Interview Summary

- Quantitative risk modeling using event trees and fault trees.
- Focus on sprinkler reliability, door closure effectiveness, and stairwell integrity.
- Seek Minnesota-specific data to improve modeling accuracy.
- Concerns about fire department staffing limitations, especially in rural areas.
- Highlight sprinkler system failures often due to human error (e.g., valve shutoffs).
- Stress the importance of education, maintenance, and realistic expectations for shelter-in-place strategies.

TAG Interview Summary

- Variability in enforcement, inspection, and reporting.
- Elevator inclusion driven by practicality, not just code.
- Emphasize the need for smoke control systems and compartmentalization in single-stair designs.
- Concerns about egress width, stretcher maneuverability, and elevator access.
- Flexible units, garden-level units offer design opportunities.
- Market drives requirements of affordability, lot size constraints, and unit sizing.
- Larger units more desirable post-COVID.
- Single-stair designs viable in smaller lots/buildings.
- Examples from New York, Seattle, and Europe where single-stair buildings are common.
- Emphasize the importance of passive systems, building separation, and realistic modeling.

TAG Interview Summary – Opportunities and Questions

- Sprinkler performance data (especially MN-specific, NFPA 13 vs 13R systems).
- Fire incident data (e.g., ignition sources, fire spread, injuries).
- Inspection and maintenance records (e.g., door closers, alarm systems).
- Building stock characteristics (e.g., construction type, floor count, elevator presence).
- Human behavior modeling (e.g., door propping, e-bike charging in stairwells).
- Potentially incomplete or inconsistent data (e.g., NFIRS, NFPA reports).
- Political and emotional issue.
- Importance and potential variability in enforcement and inspection across jurisdictions.
- Design trade-offs between safety, cost, and practicality.

DEPARTMENT OF LABOR AND INDUSTRY

National Data Sources and Insights

Kyle Christiansen | Crux Consulting

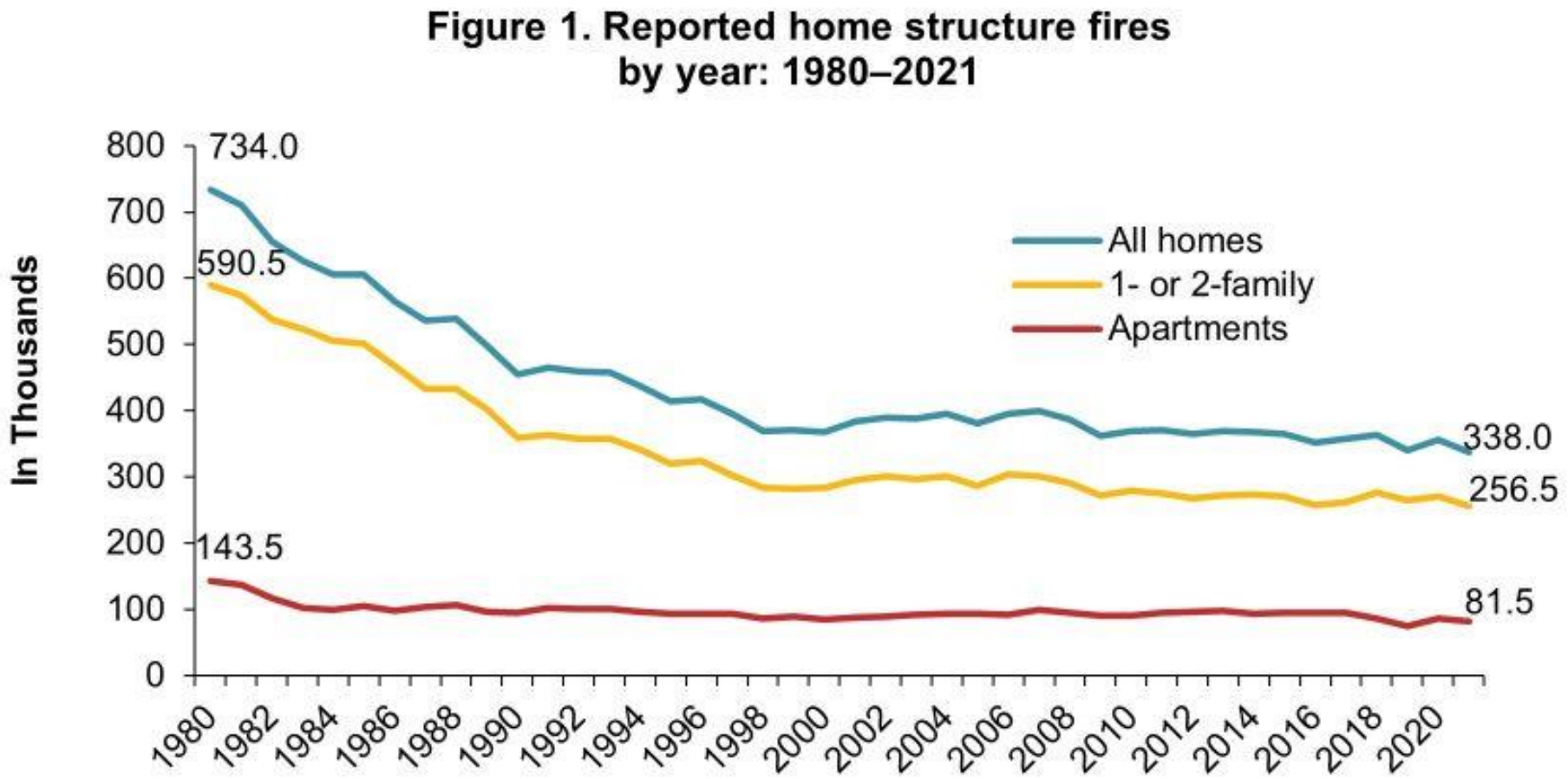
Data Overview Summary

- Literature review
  - 40+ papers, reports, and journal articles (domestic, international)
- Stakeholder interviews
  - 12 TAG members interviewed for perspective and insights
- Data requests
  - NFPA, Minnesota State Fire Marshal's Office, National Fire Sprinkler Association, Housing First, Center for Building

National Fire Event Data Received

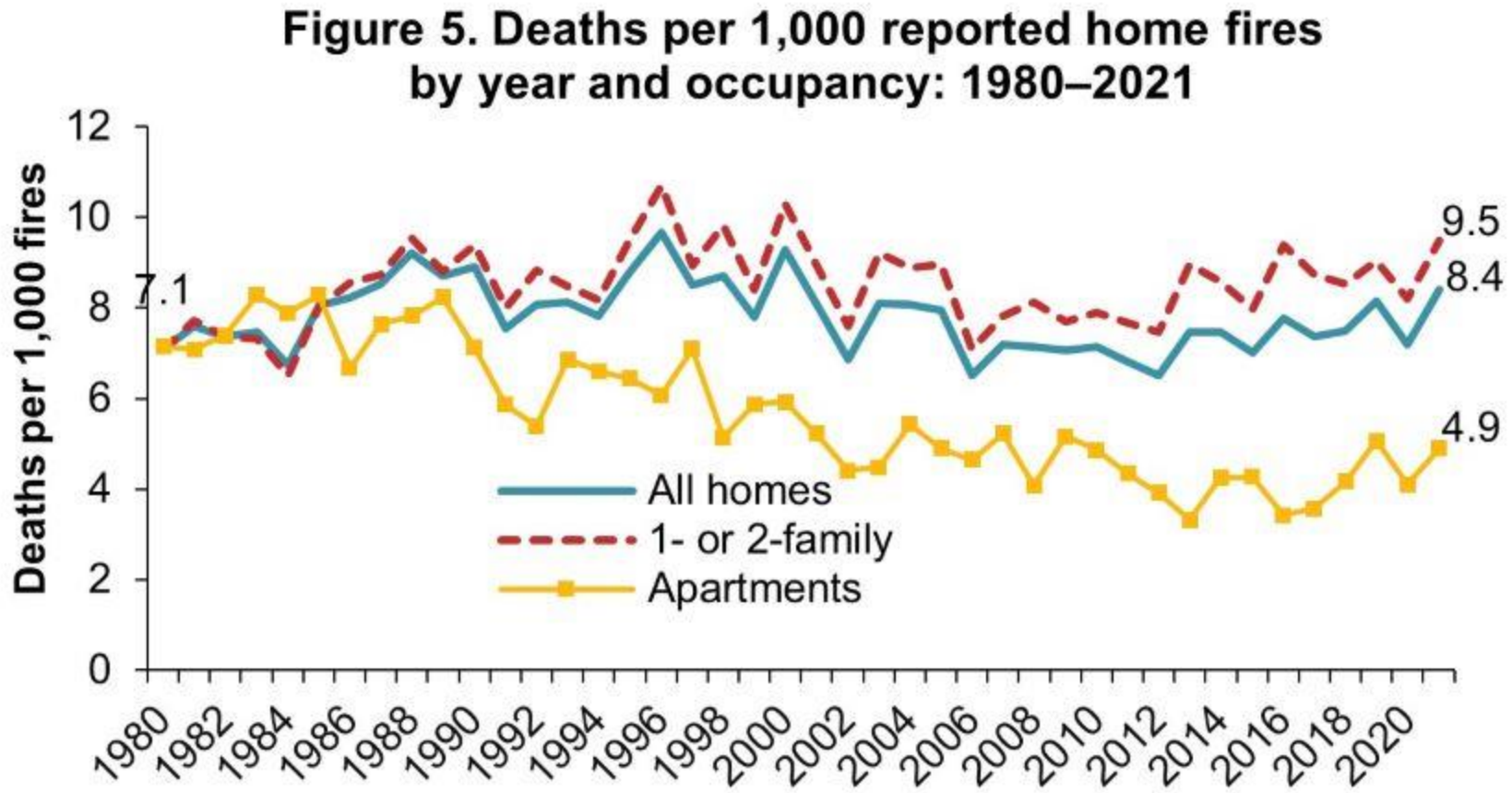
- National Fire Protection Association (NFPA)
  - Paid NFPA to perform custom analysis for MFH fire events from 1999 - 2023
- NFIRS data collection approach changed in 2003 (version 5.0)
- Current data limitations
  - NFIRS estimated to capture ~70% of annual fire events
  - NFPA applies scaling factor to reflect national data set
  - Number of exit stairs in a building not available
  - Variability in user interpretations of fields
  - Firefighter injuries not available

Residential Home Structure Fires (National)



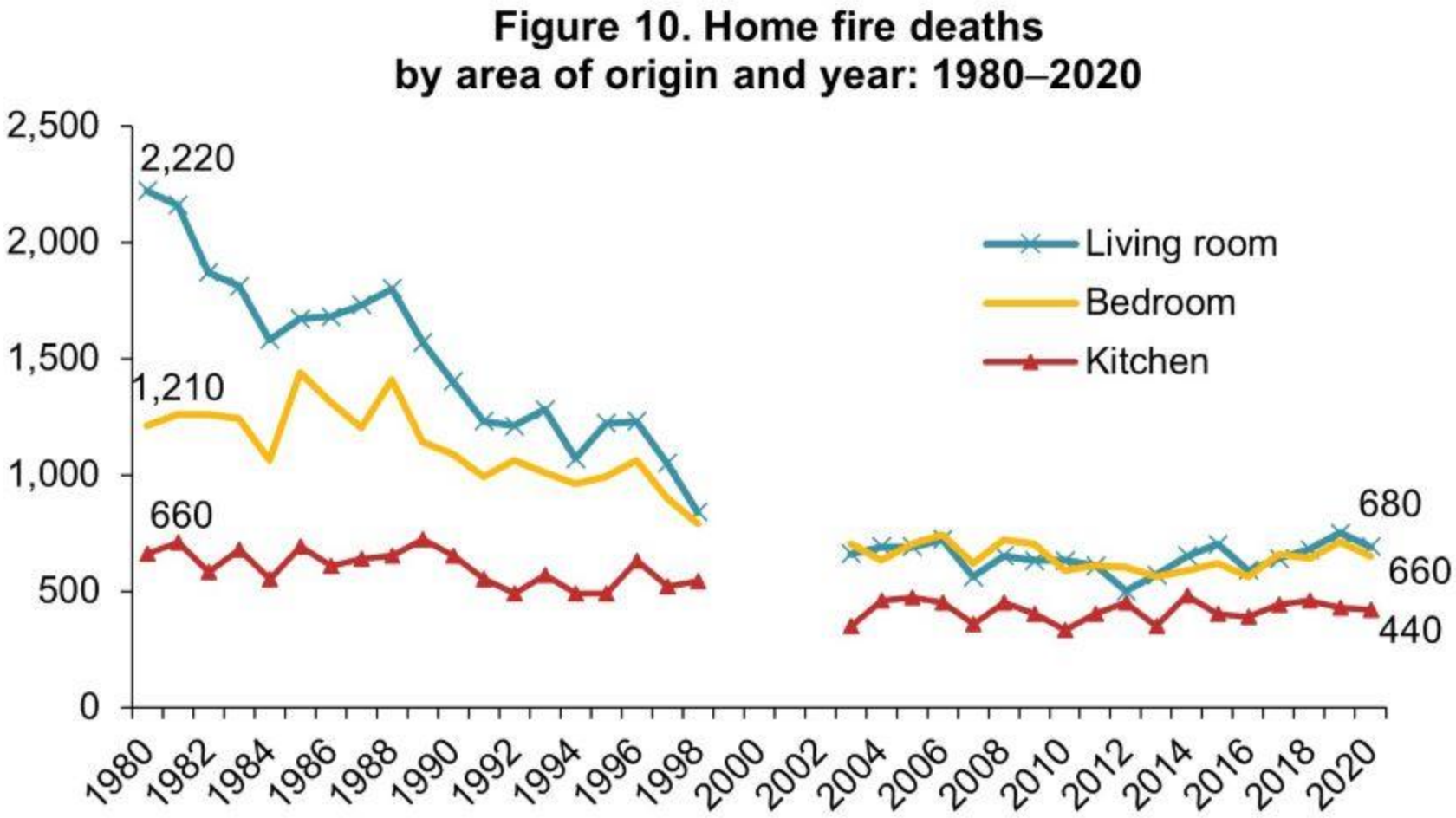
https://www.nfpa.org/education-and-research/research/nfpa-research/fire-statistical-reports/home-structure-fires

Normalized Residential Death Rate (National)



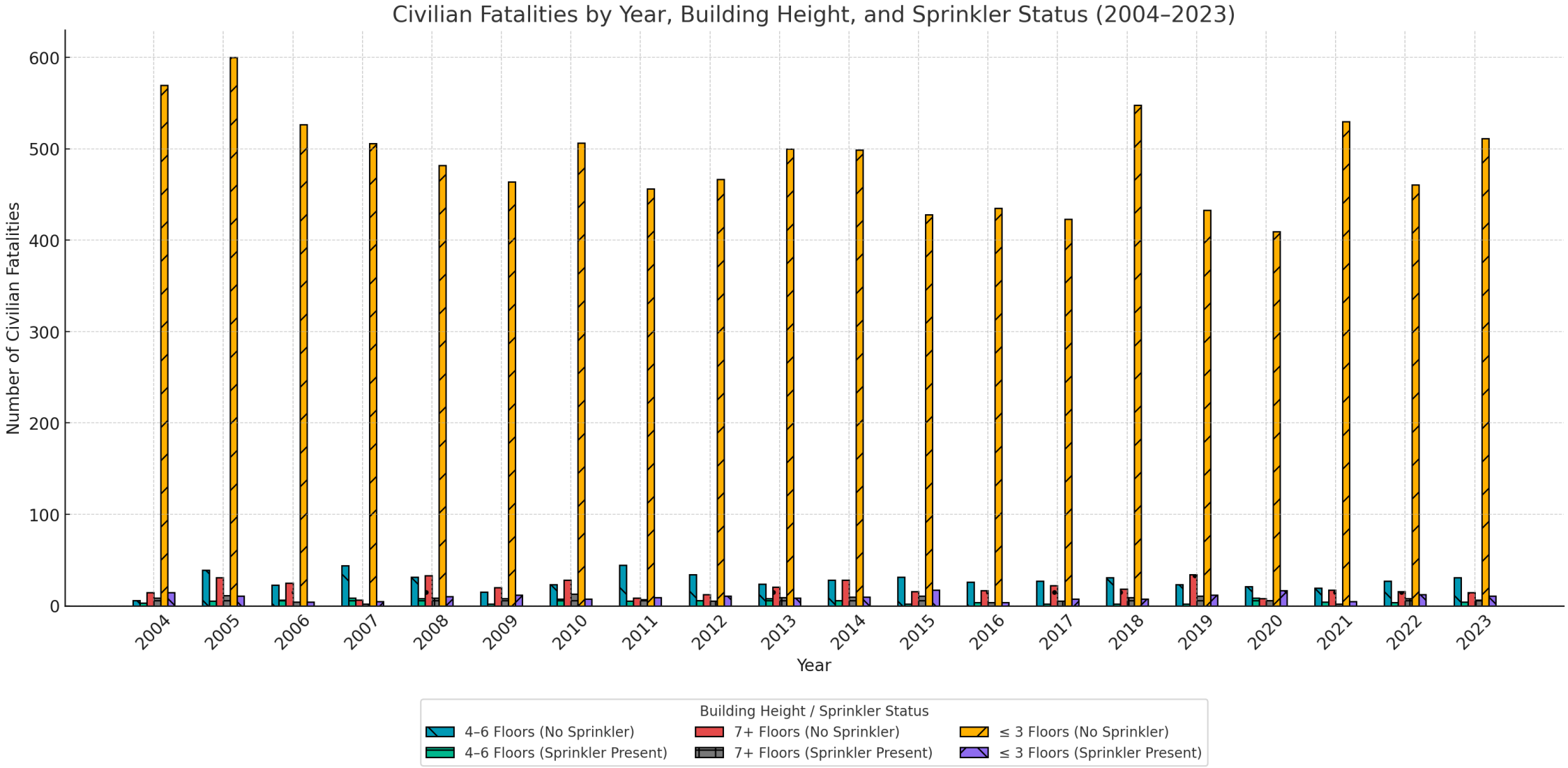
https://www.nfpa.org/education-and-research/research/nfpa-research/fire-statistical-reports/home-structure-fires

Home Fire Deaths by Area of Origin (National)



https://www.nfpa.org/education-and-research/research/nfpa-research/fire-statistical-reports/home-structure-fires

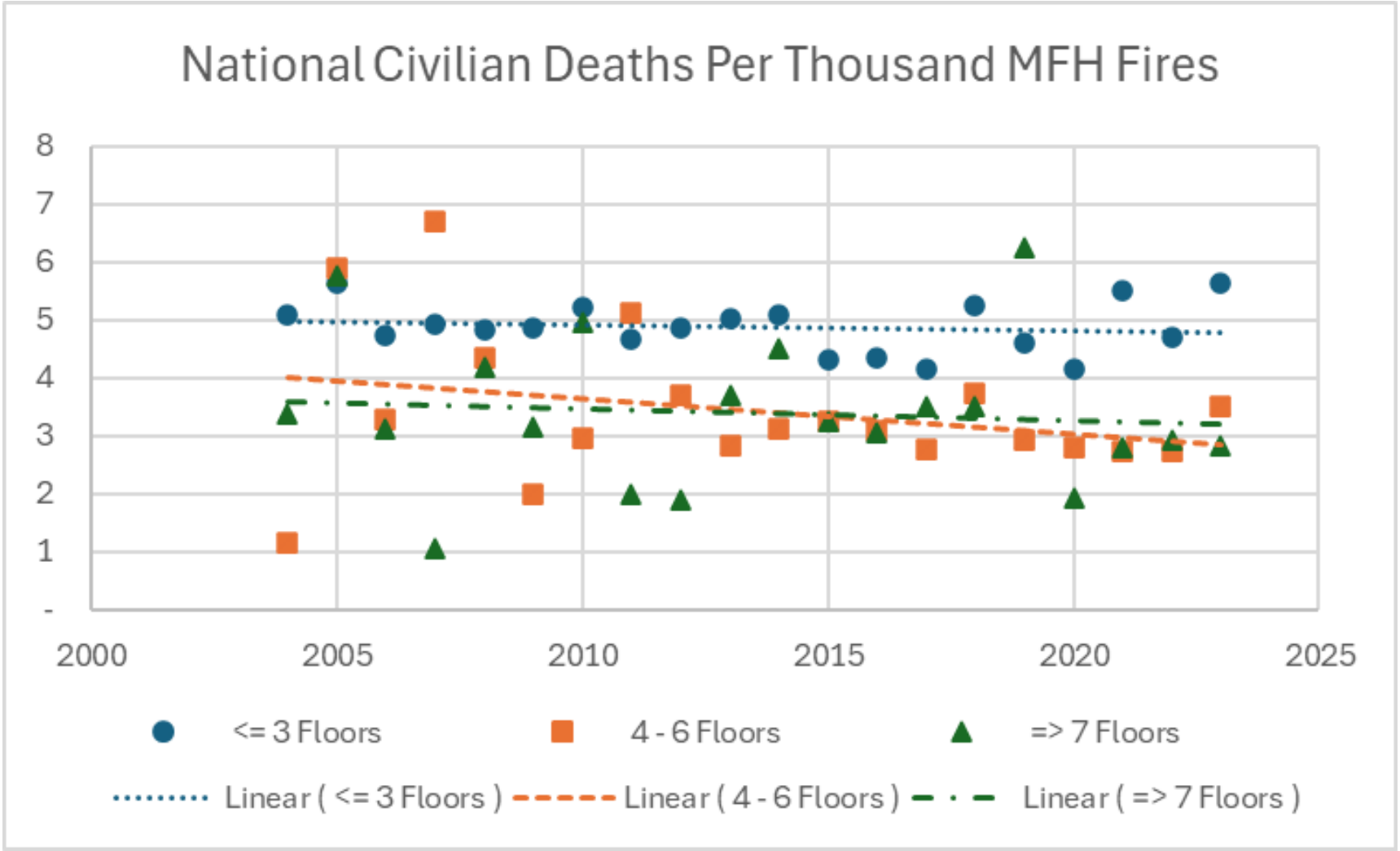
Civilian Fatalities in Multi-Family Housing (National)



NFPA Custom MFH Fire Event Data (2004 – 2023)

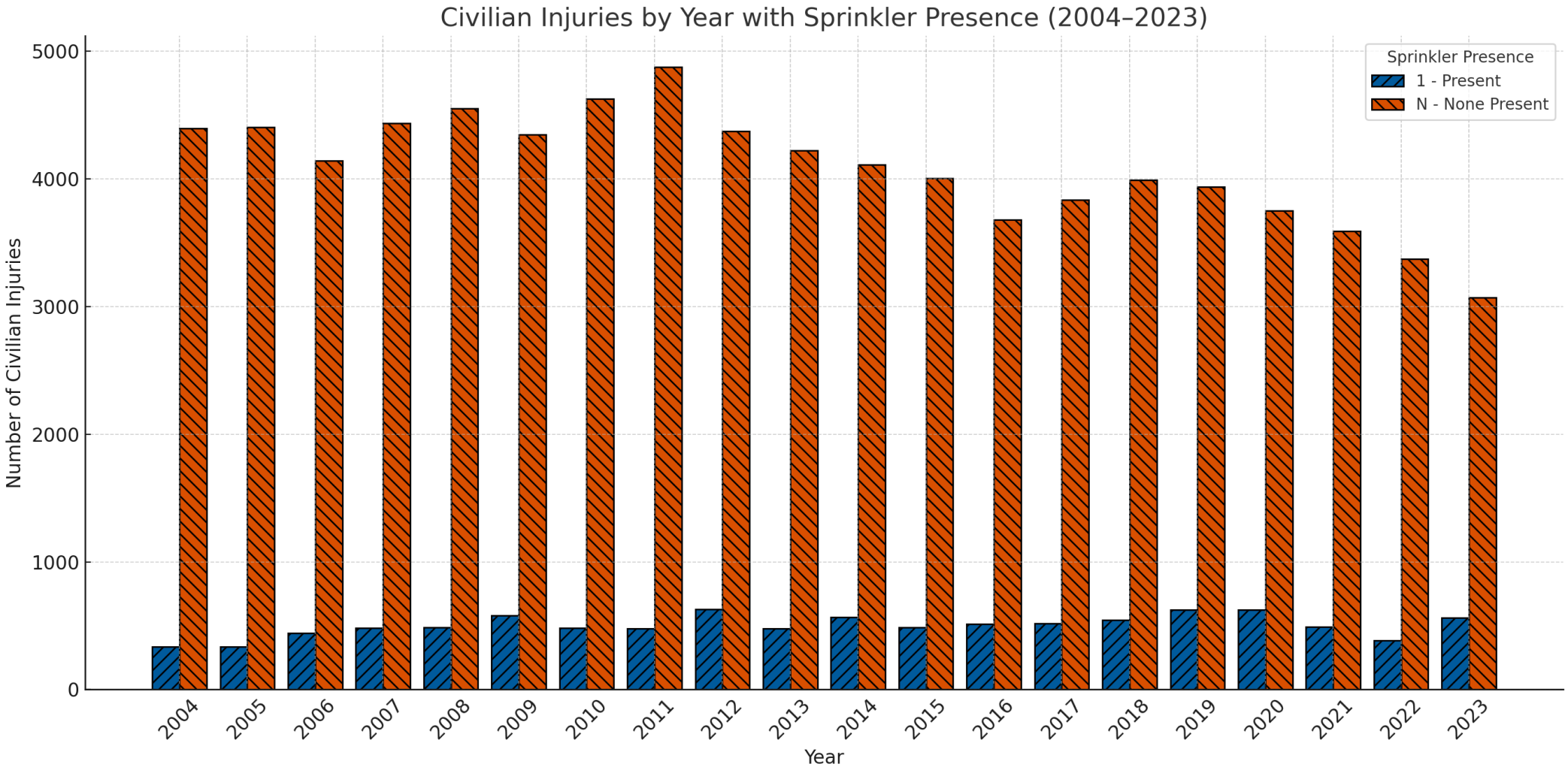
6/25/2025

Civilian Deaths vs Building Height (National)



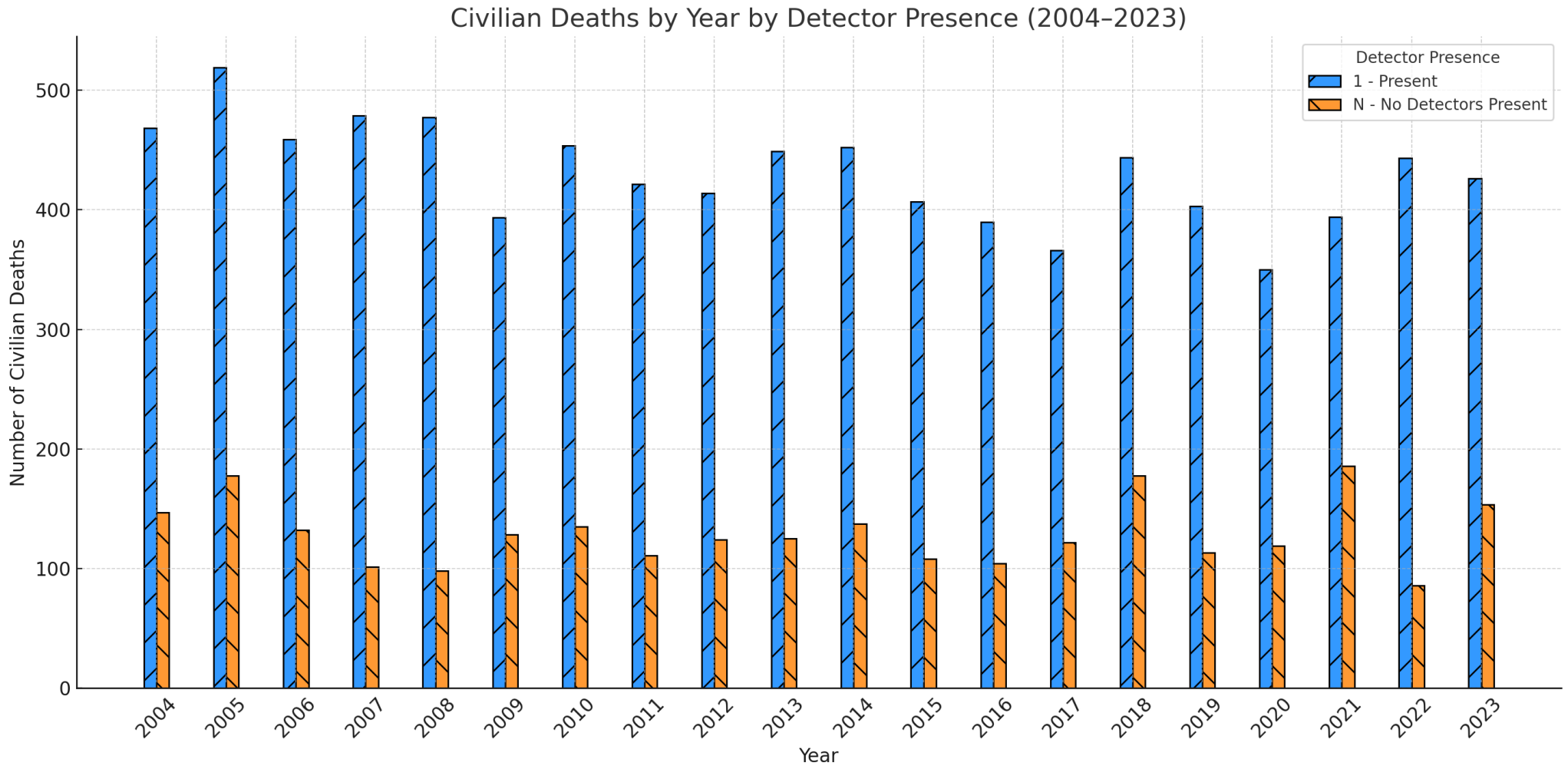
NFPA Custom MFH Fire Event Data (2004 – 2023)

Sprinkler Systems vs Civilian Injuries in MFH Fires (National)



NFPA Custom MFH Fire Event Data (2004 – 2023)

Smoke Detectors vs Civilian Deaths in MFH Fires (National)



NFPA Custom MFH Fire Event Data (2004 – 2023)

Smoke Detectors vs Deaths Per 1,000 Events in MFH Fires (National)

NFPA Custom MFH Fire Event Data (2004 – 2023)

DEPARTMENT OF LABOR AND INDUSTRY

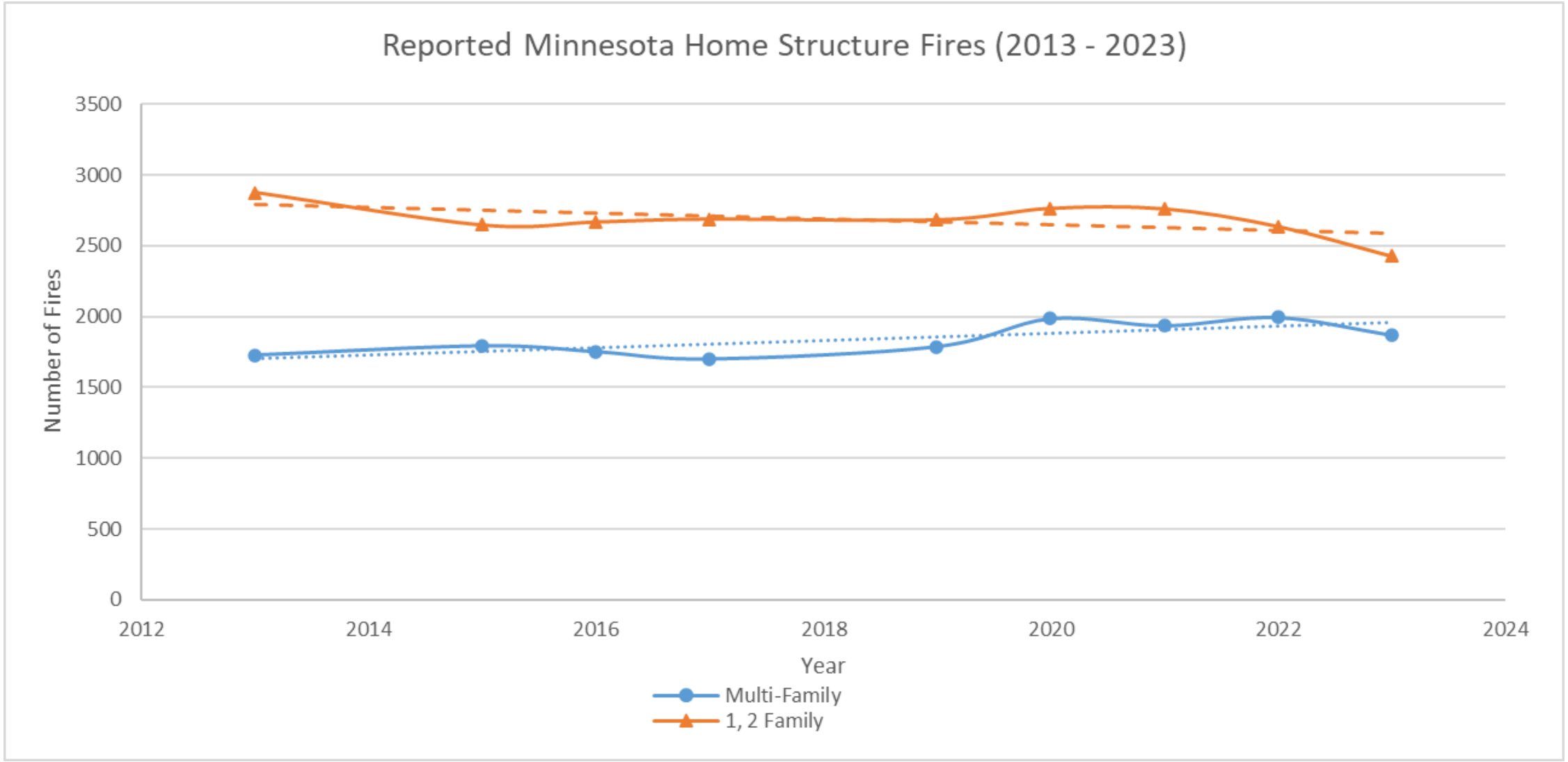
Minnesota Data Sources and Insights

Kyle Christiansen | Crux Consulting

Minnesota Fire Event Data Received

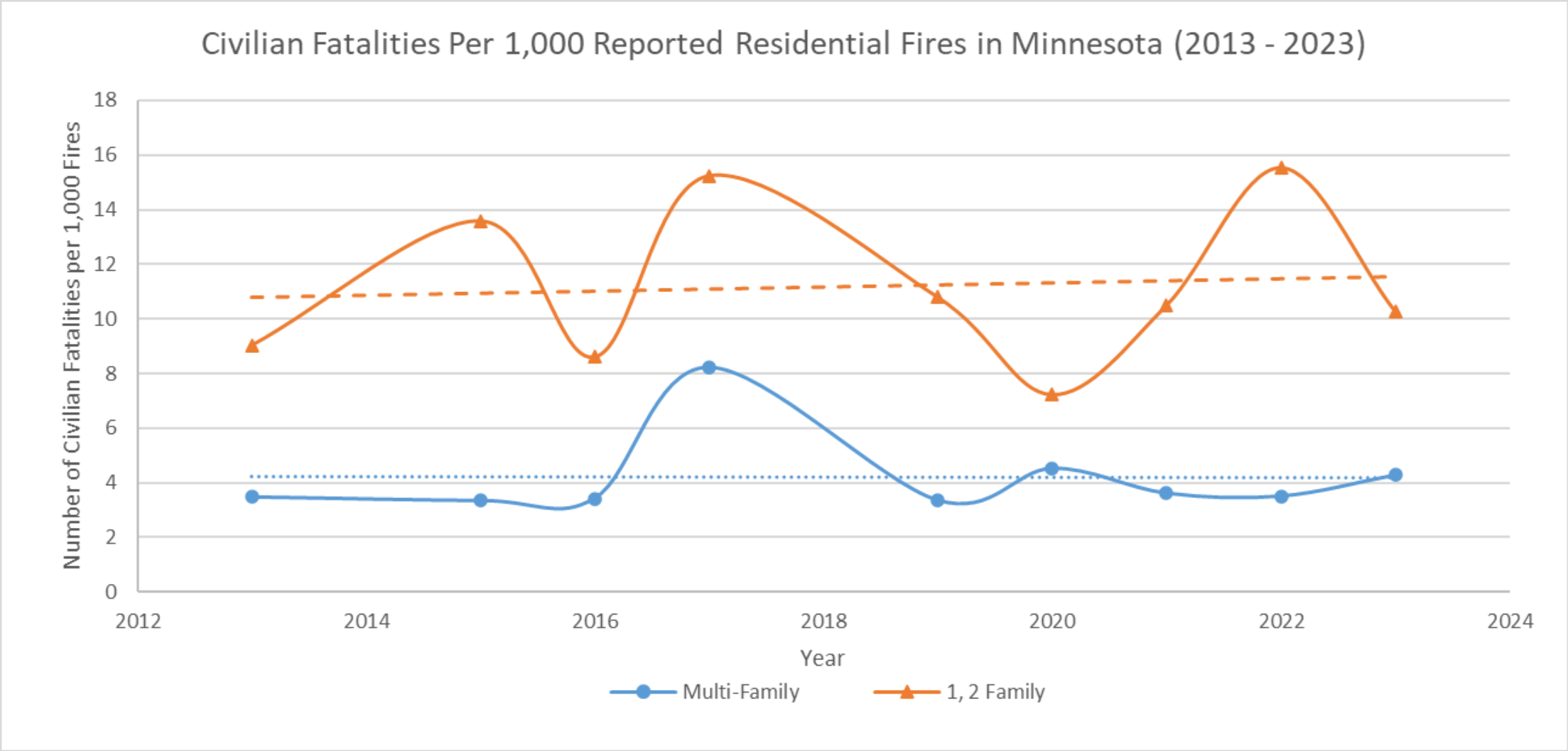
- Residential fires provided from 2002 - 2025
  - Data range analyzed: 2004 - 2024
- Minnesota data from the State Fire Marshal Division
- Consistently high (> ~92%) reporting from MN fire departments
- Minnesota Fire Statistics Reports published annually

Residential Home Structure Fires (Minnesota)



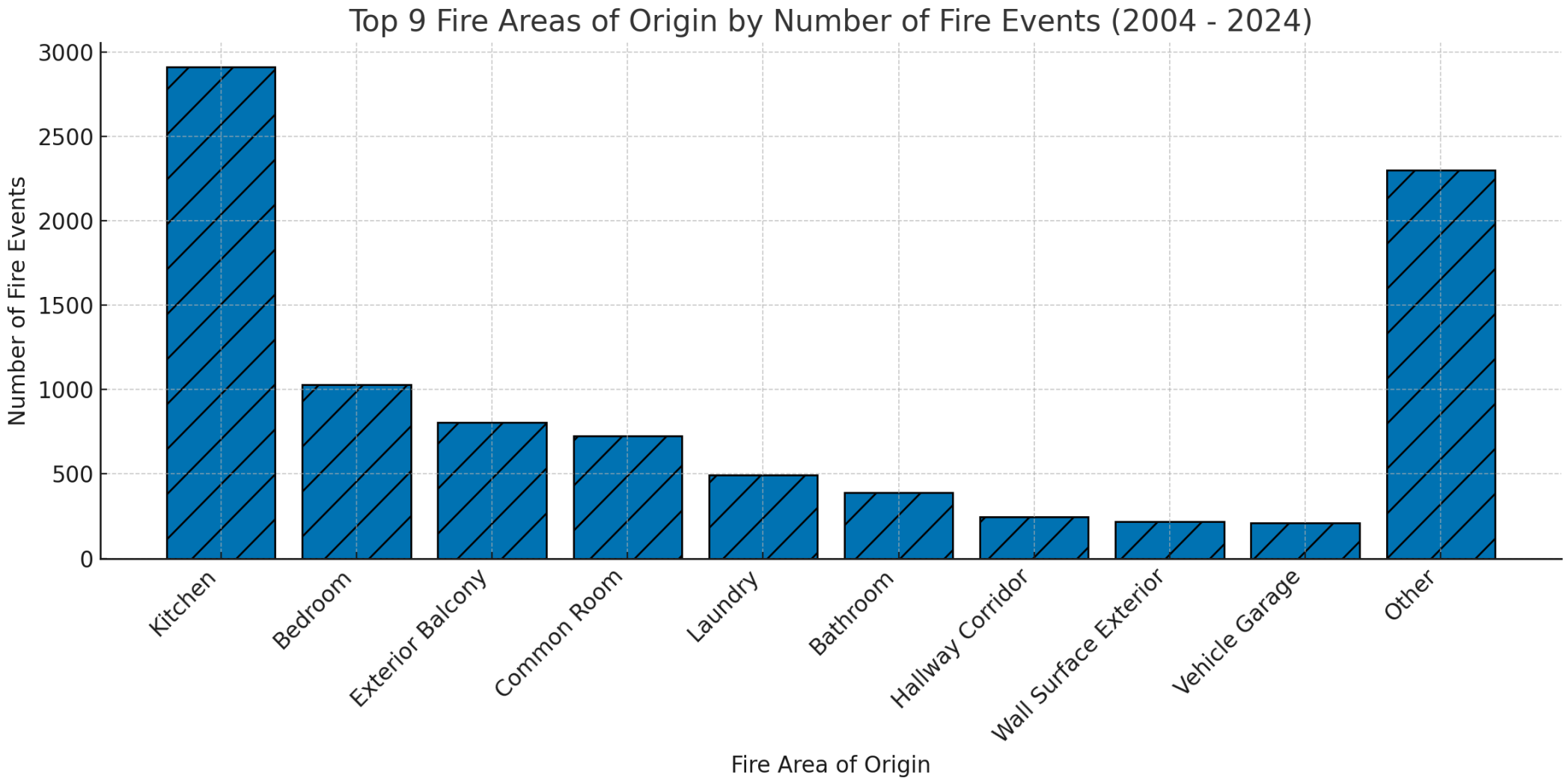
"Annual Fire in Minnesota" Reports, Minnesota Department of Public Safety's State Fire Marshal Division

Normalized Residential Death Rate (Minnesota)



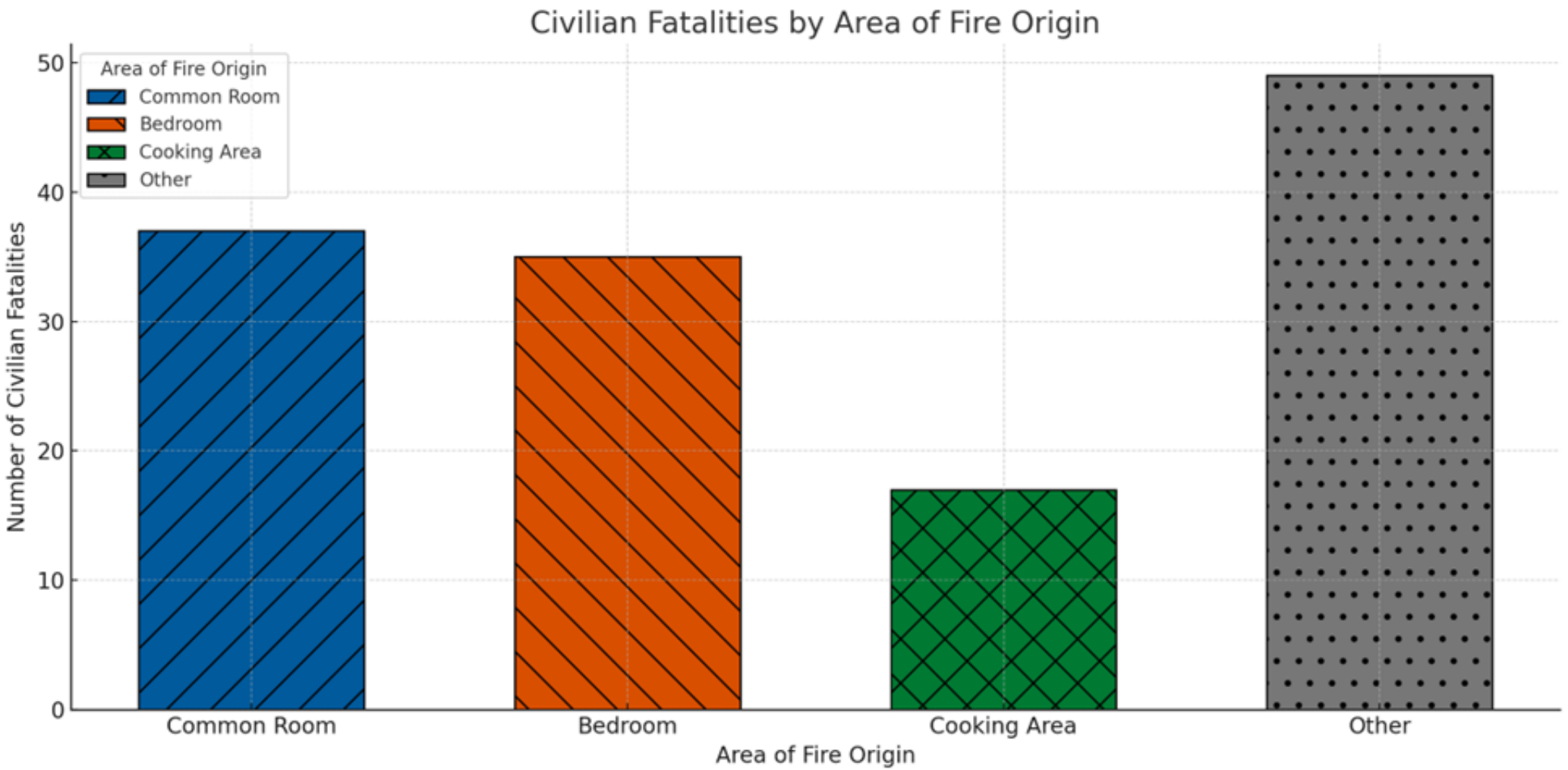
"Annual Fire in Minnesota" Reports, Minnesota Department of Public Safety's State Fire Marshal Division

MFH Fire Area of Origin (Minnesota)



Minnesota Fire Event Data (2004 – 2024, Multifamily Dwelling), State Fire Marshal's Office

MFH Fire Area of Origin Versus Civilian Fatalities (Minnesota)



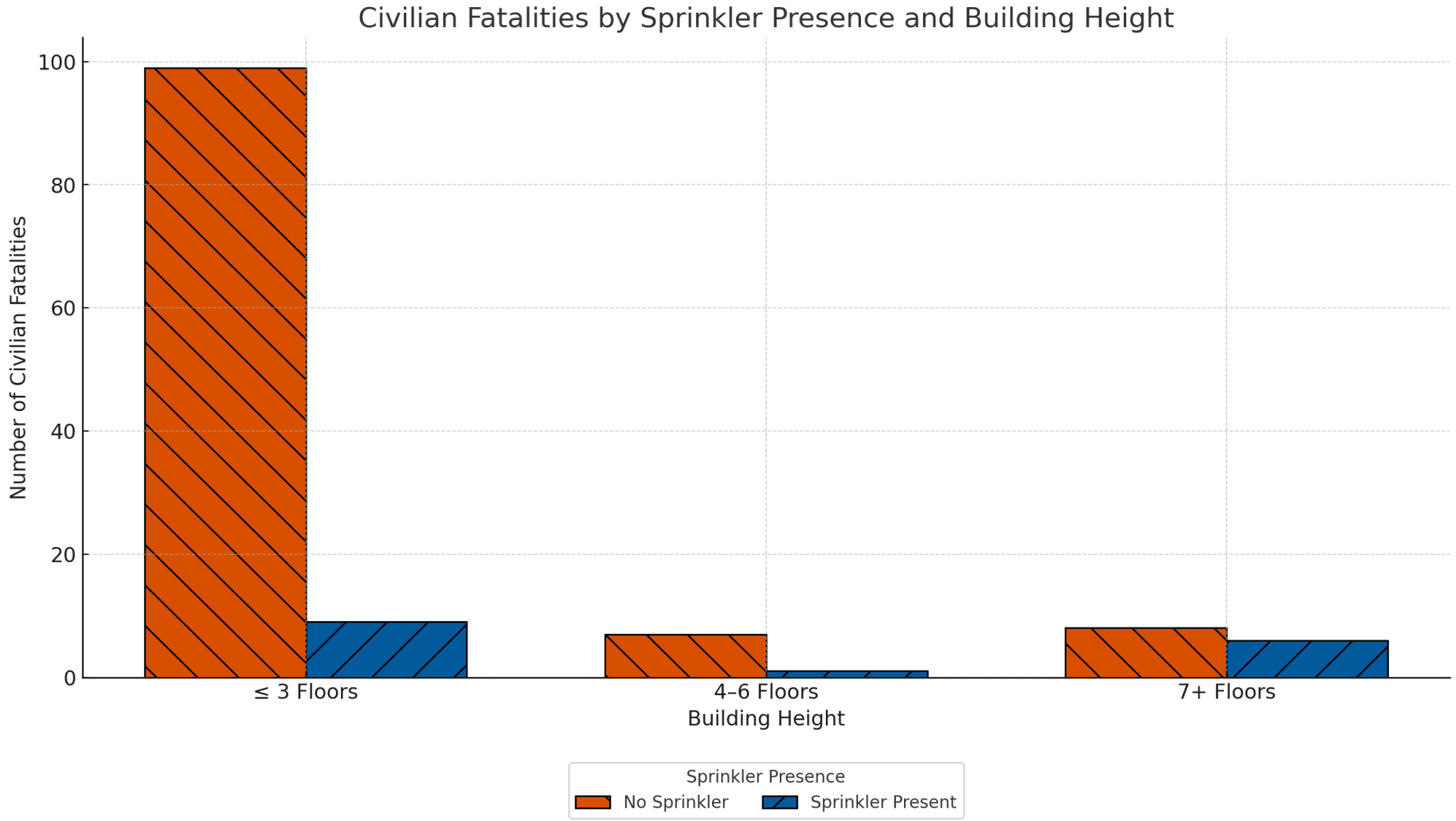
Minnesota Fire Event Data (2004 – 2024, Multifamily Dwelling), State Fire Marshal's Office

Fire Summary in MFH Common Spaces (Minnesota)

- 179 fires occurred in interior stair or ramp
  - 0 civilian deaths
  - 6 firefighter injuries
  - 164 of these fires occurred in buildings with 1 – 3 stories
- 244 fires occurred in hallway corridors
  - 0 civilian deaths
  - 11 firefighter injuries
  - 188 of these fires occurred in buildings with 1 – 3 stories

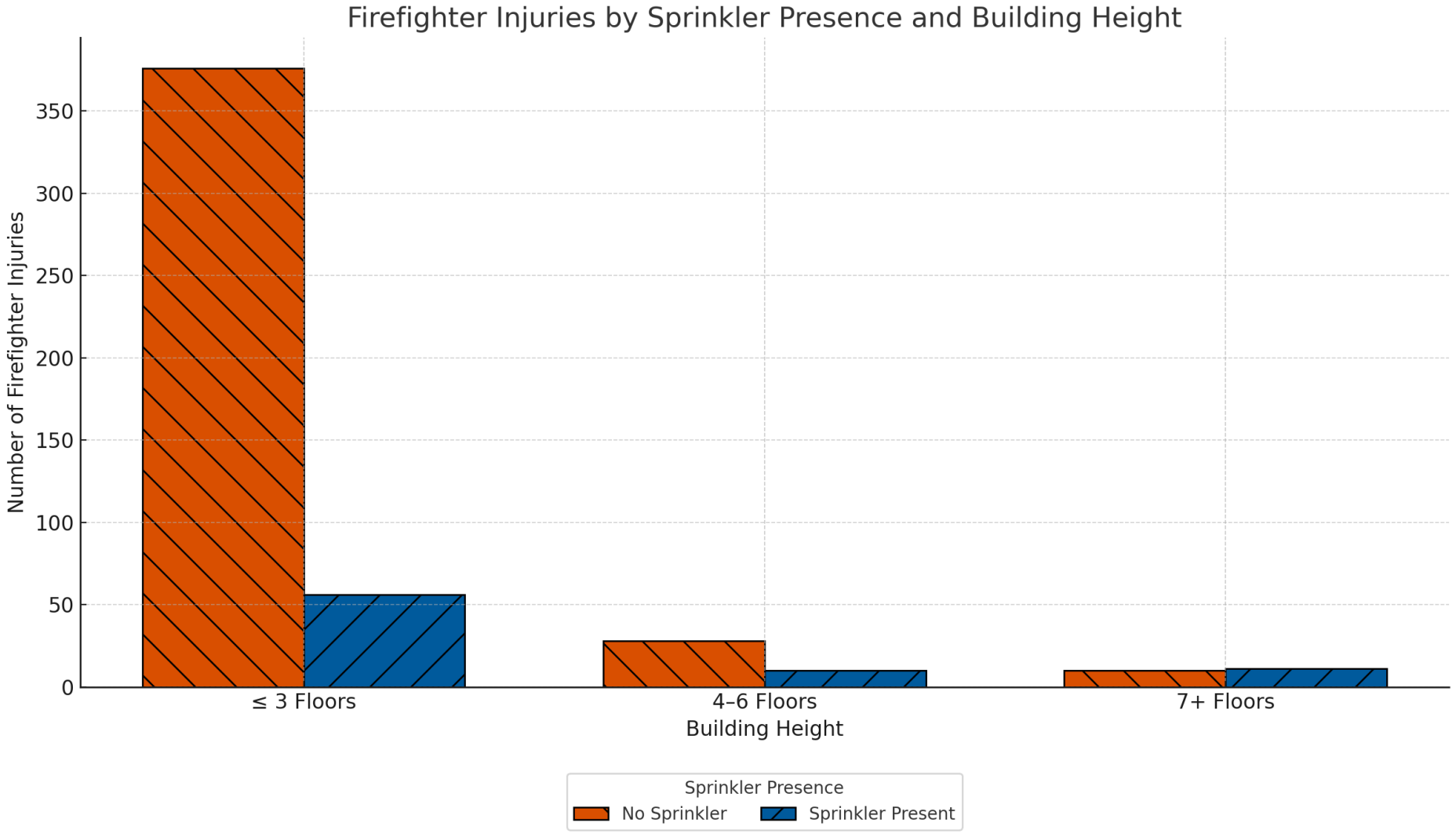
Minnesota Fire Event Data (2004 – 2024, Multifamily Dwelling), State Fire Marshal's Office

Civilian Fatalities in Multi-Family Housing (Minnesota)



Minnesota Fire Event Data (2004 – 2024, Multifamily Dwelling), State Fire Marshal's Office

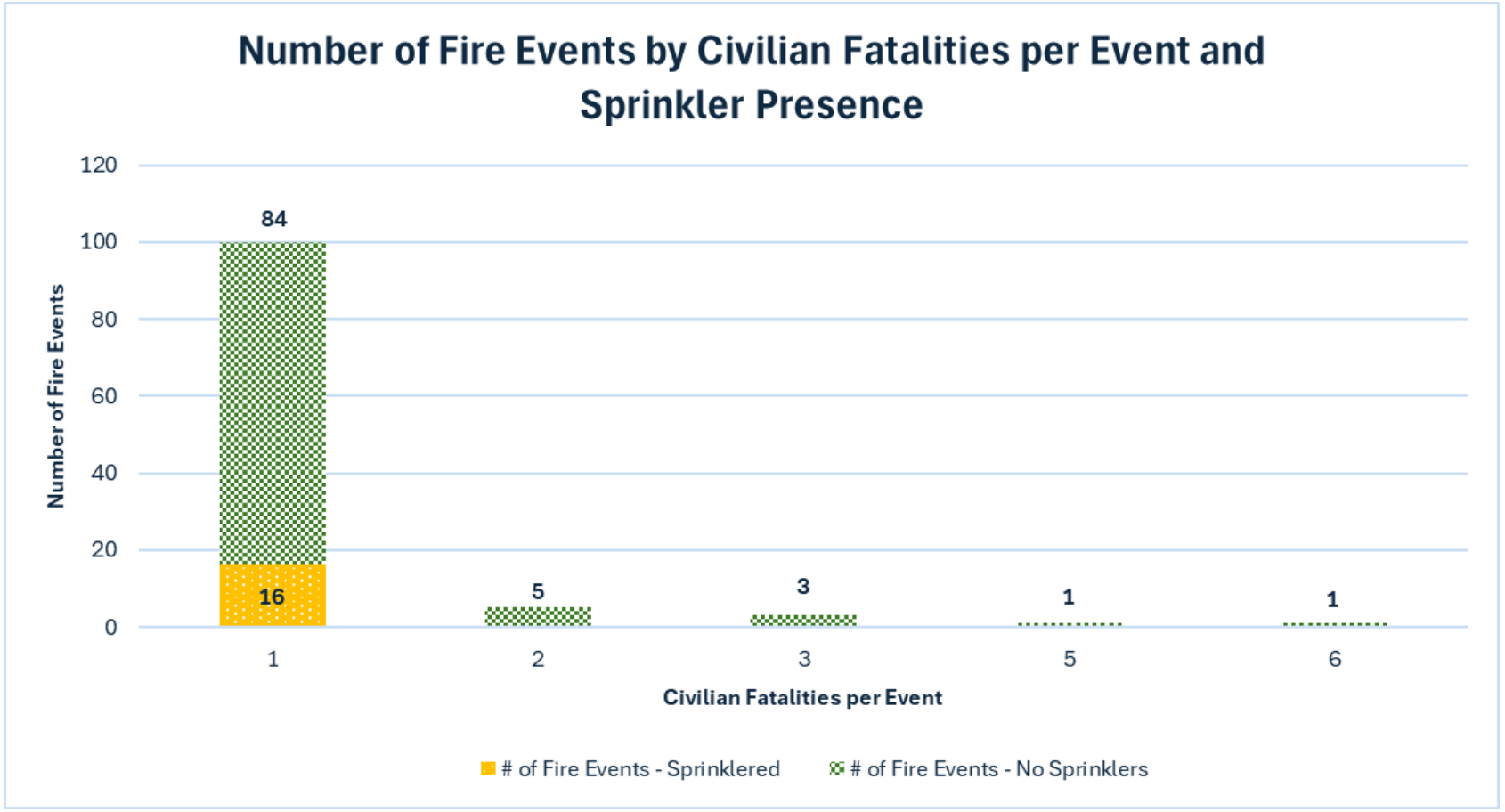
Firefighter Injuries in Multi-Family Housing (Minnesota)



Minnesota Fire Event Data (2004 – 2024, Multifamily Dwelling), State Fire Marshal's Office

Magnitude of Events that Occur – Civilian Fatalities

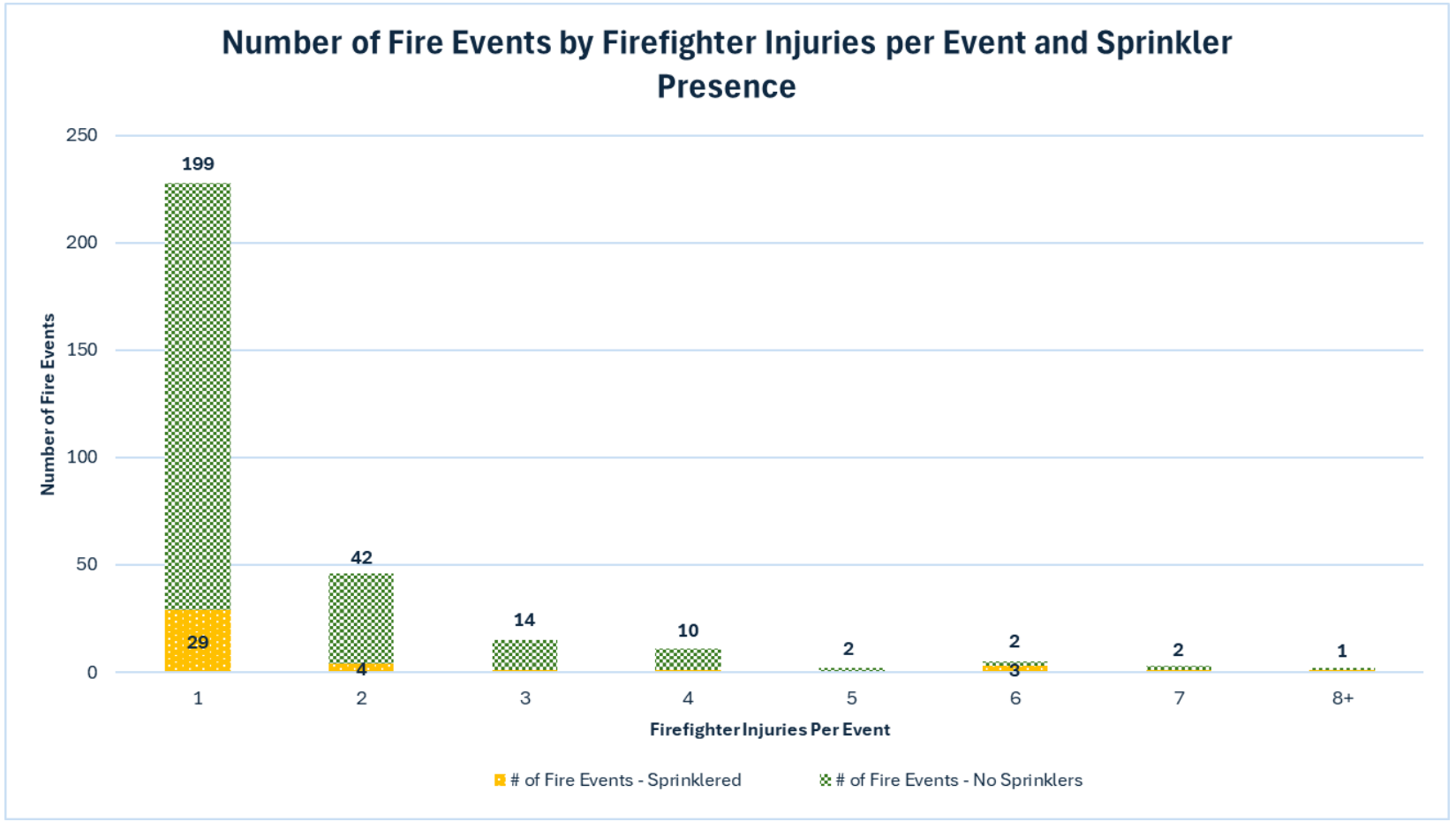
- 9,694 (98.8%) of MFH fires between 2004 - 2024 resulted in 0 civilian deaths



Minnesota Fire Event Data (2004 – 2024, Multifamily Dwelling), State Fire Marshal's Office

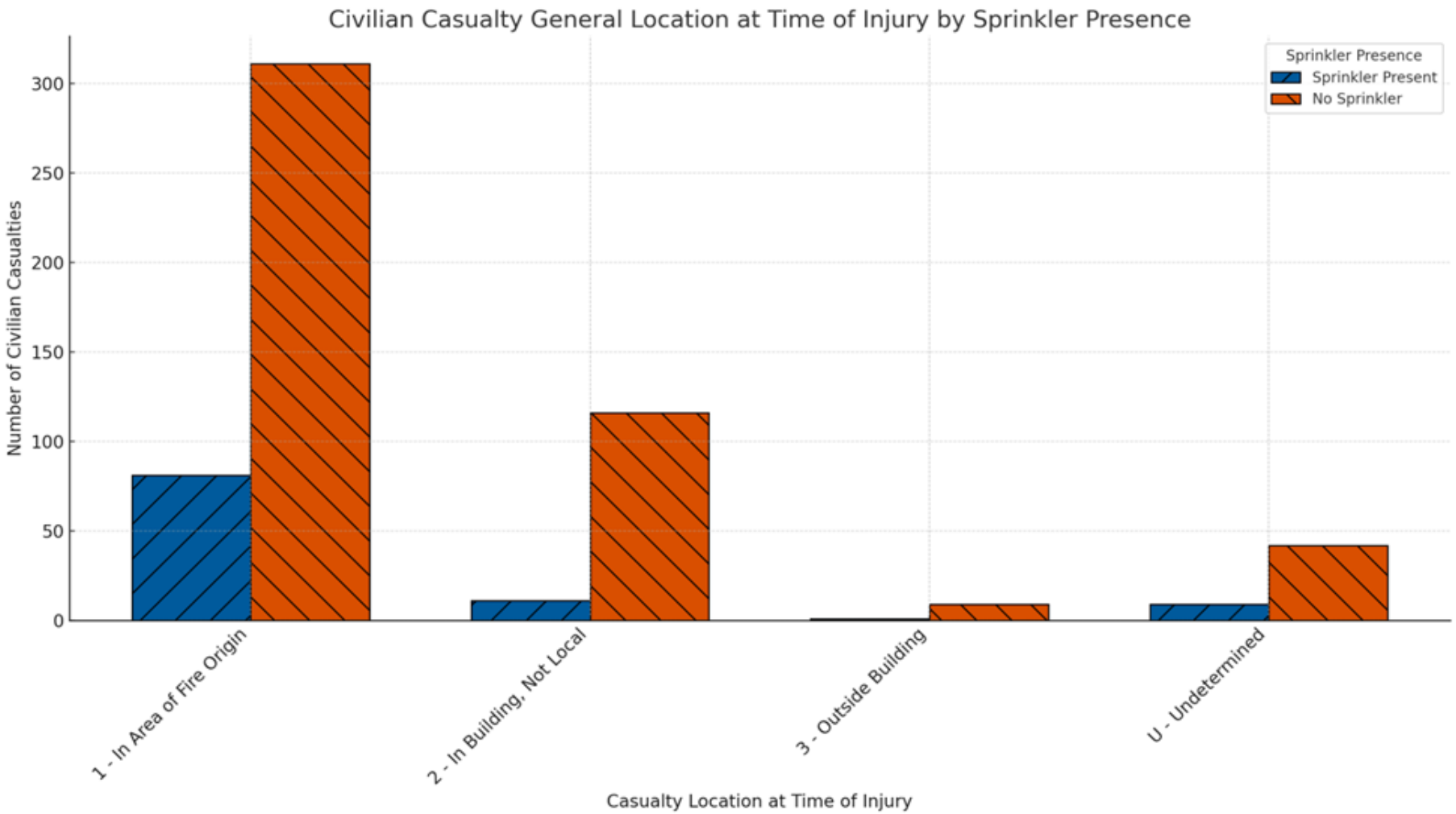
Magnitude of Events that Occur – Firefighter Injuries

- 9,467 (96.5%) of MFH fires between 2004 – 2024 resulted in 0 firefighter injuries



Minnesota Fire Event Data (2004 – 2024, Multifamily Dwelling), State Fire Marshal's Office

Civilian Fatality Based on Location and Sprinklers (MN)



Minnesota Fire Event Data (2004 – 2024, Multifamily Dwelling), State Fire Marshal's Office

What Has the Data Told Us?

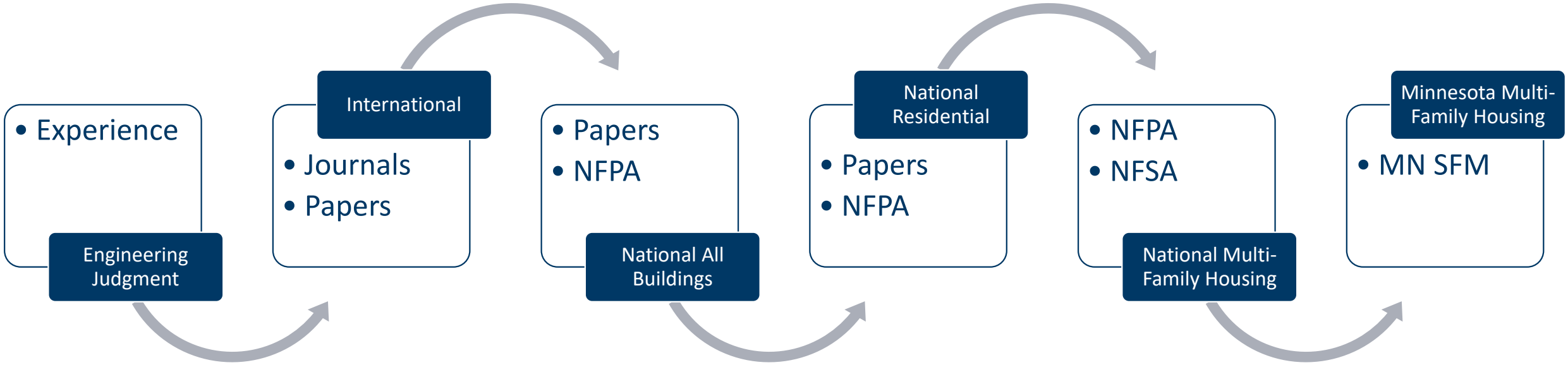
- Difference in risk between 1, 2 family homes and multi-family structures
- Most fires start in the kitchen but living room / bedroom fires result in more civilian fatalities per event
- Sprinklers are effective at reducing civilian fatalities and firefighter injuries
- Fire events with multiple civilian fatalities / firefighter injuries are low in sprinklered MFH
- Fires in means of egress have not resulted in civilian deaths
- Civilian fatalities outside the fire origin are rare in sprinklered MFH

DEPARTMENT OF LABOR AND INDUSTRY

Equipment Reliability

Kyle Christiansen | Crux Consulting

Reliability Data Approach



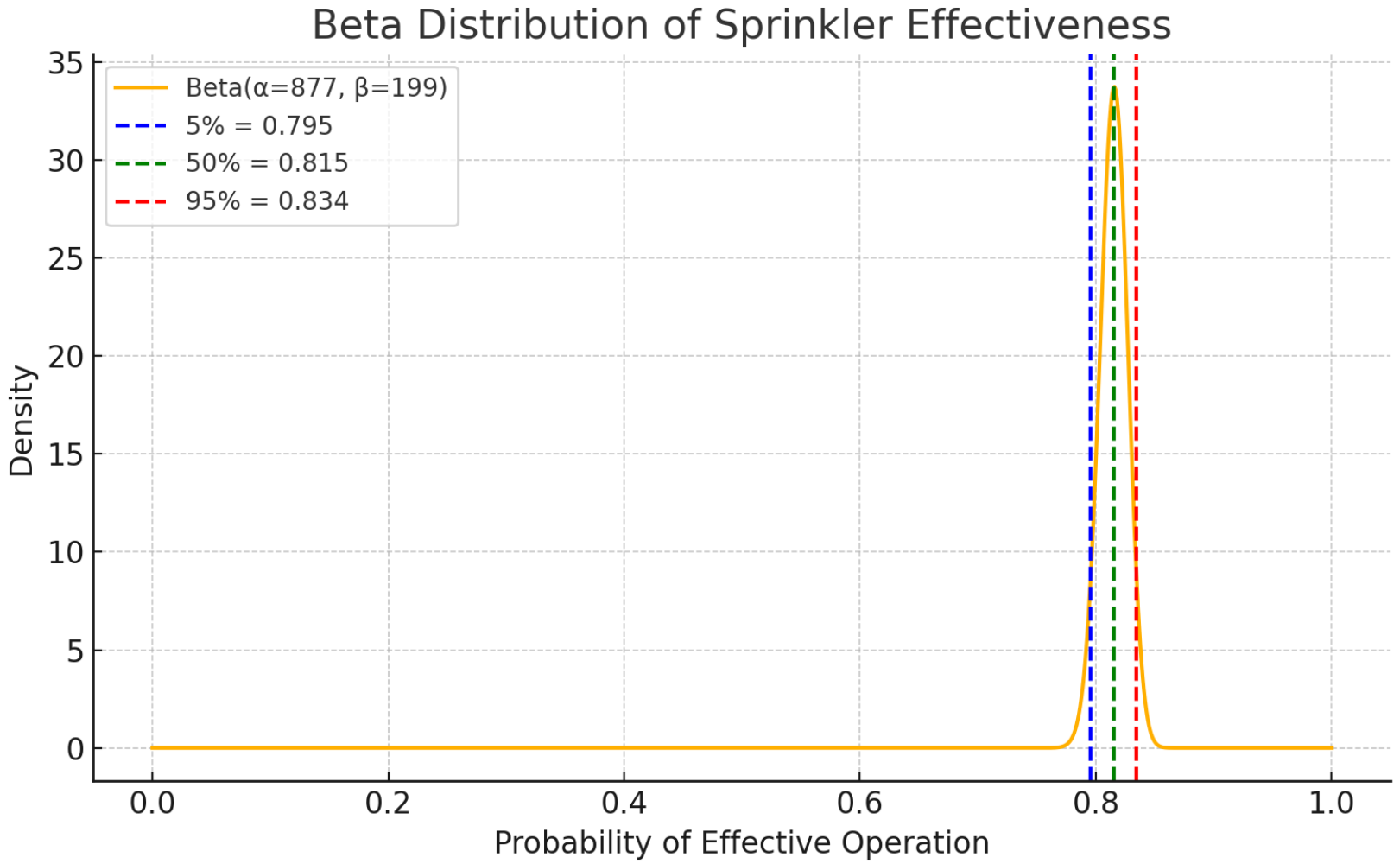
Sprinkler Reliability Data for MFH

Type	Source	Fires in Completely Sprinklered MFH	Operation of AES, Other	Operated and Effective	Operated and NOT Effective	Fire Too Small to Operate	Failed to Operate	Undetermined
National	NFSA[1]	1,988	8	876	81	438	117	84
Minnesota	MN SFM[2]	1,936	5	759	11	631	101	29

- Success = operated and effective
- Failure = operated and NOT effective, failed to operate

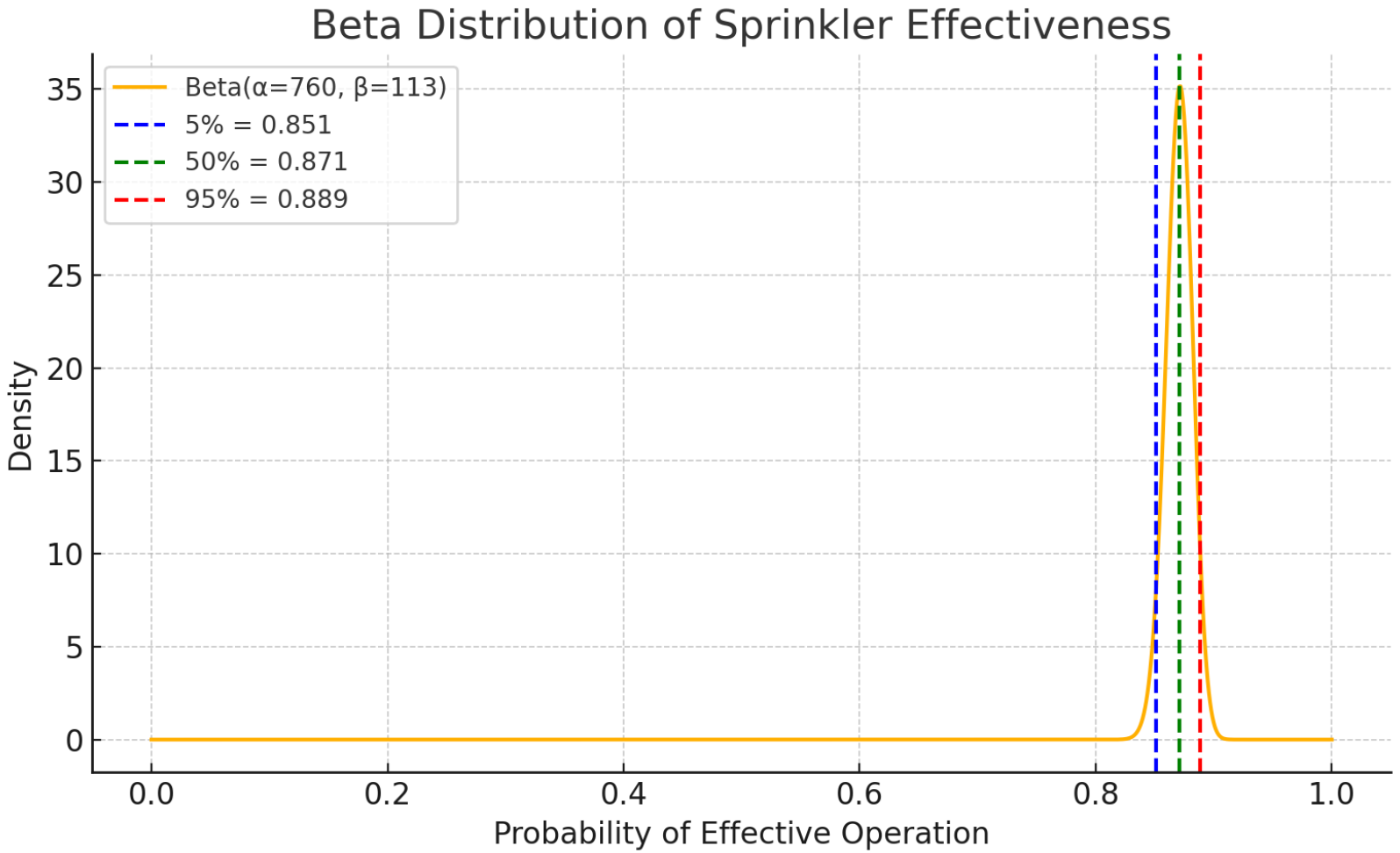
[1]National Fire Sprinkler Association Fire Event Data (2014 – 2023, Multifamily Dwelling)
[2]Minnesota Fire Event Data (2004 – 2024, Multifamily Dwelling), State Fire Marshal's Office

Sprinkler Reliability Beta Distribution (MFH, National)



National Fire Sprinkler Association (2014 – 2023, Multifamily Dwelling)

Sprinkler Reliability Beta Distribution (MFH, MN)



Minnesota Fire Event Data (2004 – 2024, Multifamily Dwelling), State Fire Marshal's Office

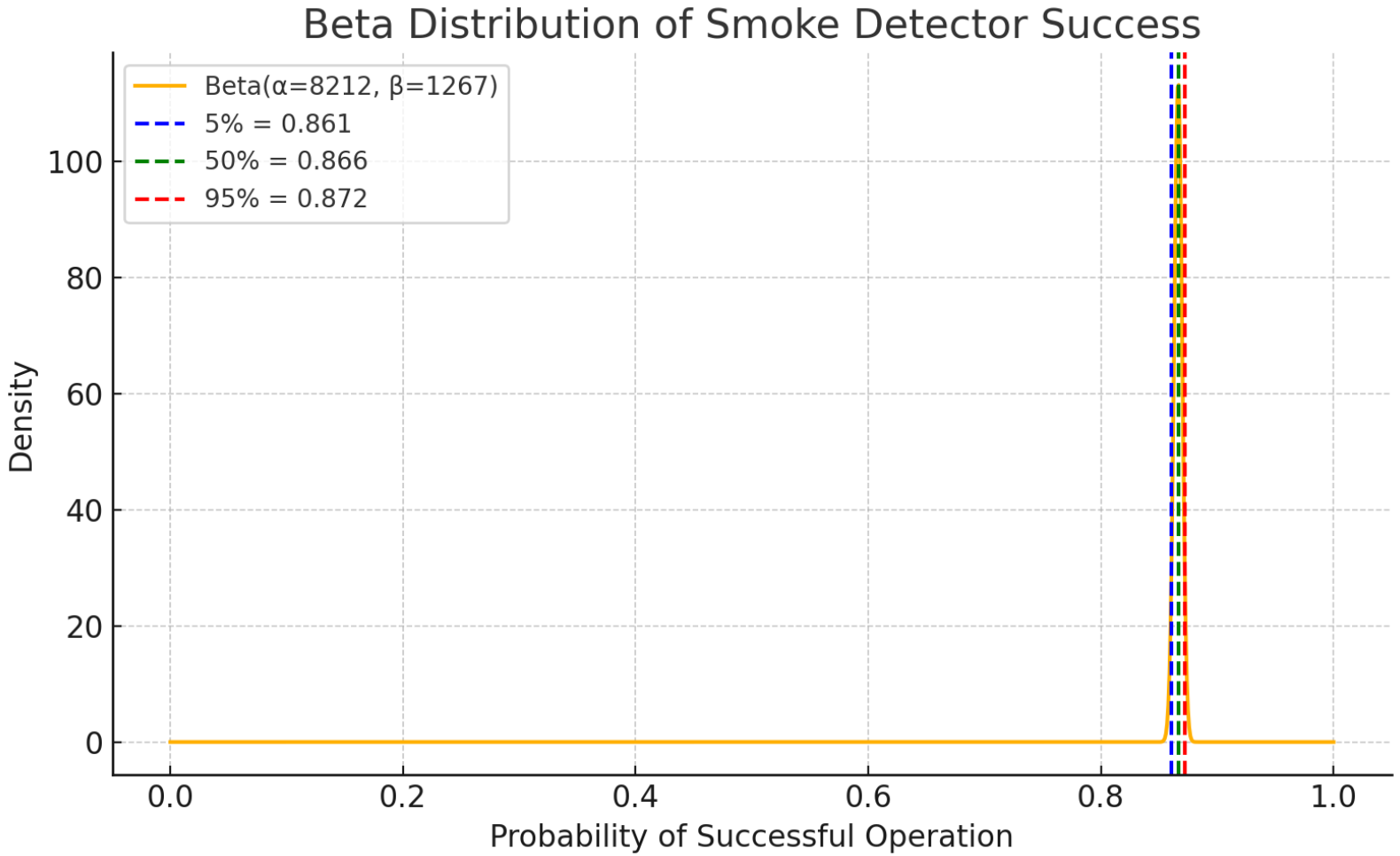
Smoke Detector Reliability Data for MFH

Type	Source	Fire Events with Detection Present	Fire Too Small to Operate	Operated	Failed to Operate	Undetermined
National	NFSA[1]	12,106	508	8,211	1,266	2,121
Minnesota	NFSA[1]	324	9	243	35	37

- Success = operated
- Failure = failed to operate

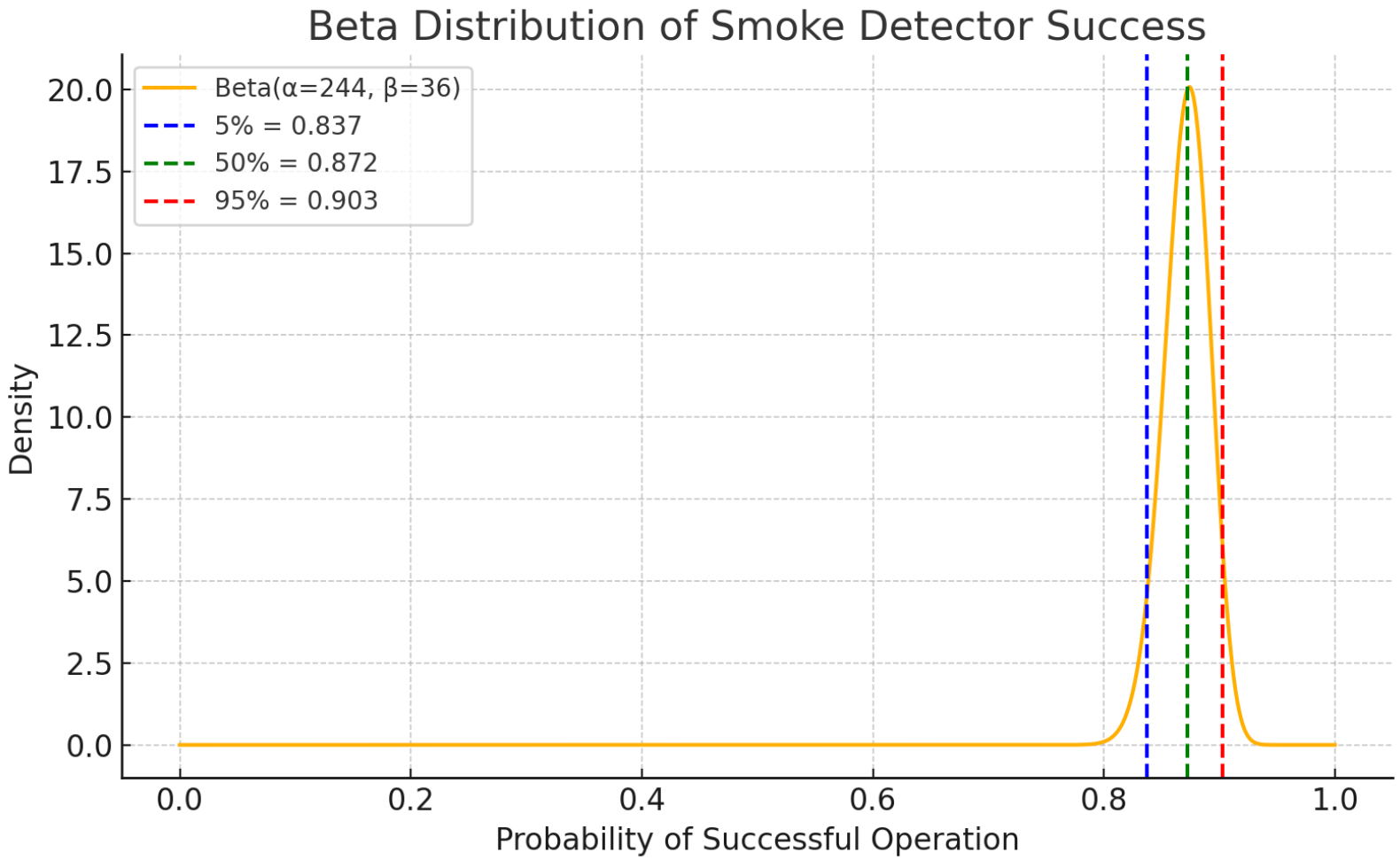
[1]National Fire Sprinkler Association Fire Event Data (2014 – 2023, Multifamily Dwelling)

Detector Reliability Beta Distribution (MFH, National)



National Fire Sprinkler Association Fire Event Data (2014 – 2023, Multifamily Dwelling)

Detector Reliability Beta Distribution (MFH, MN)



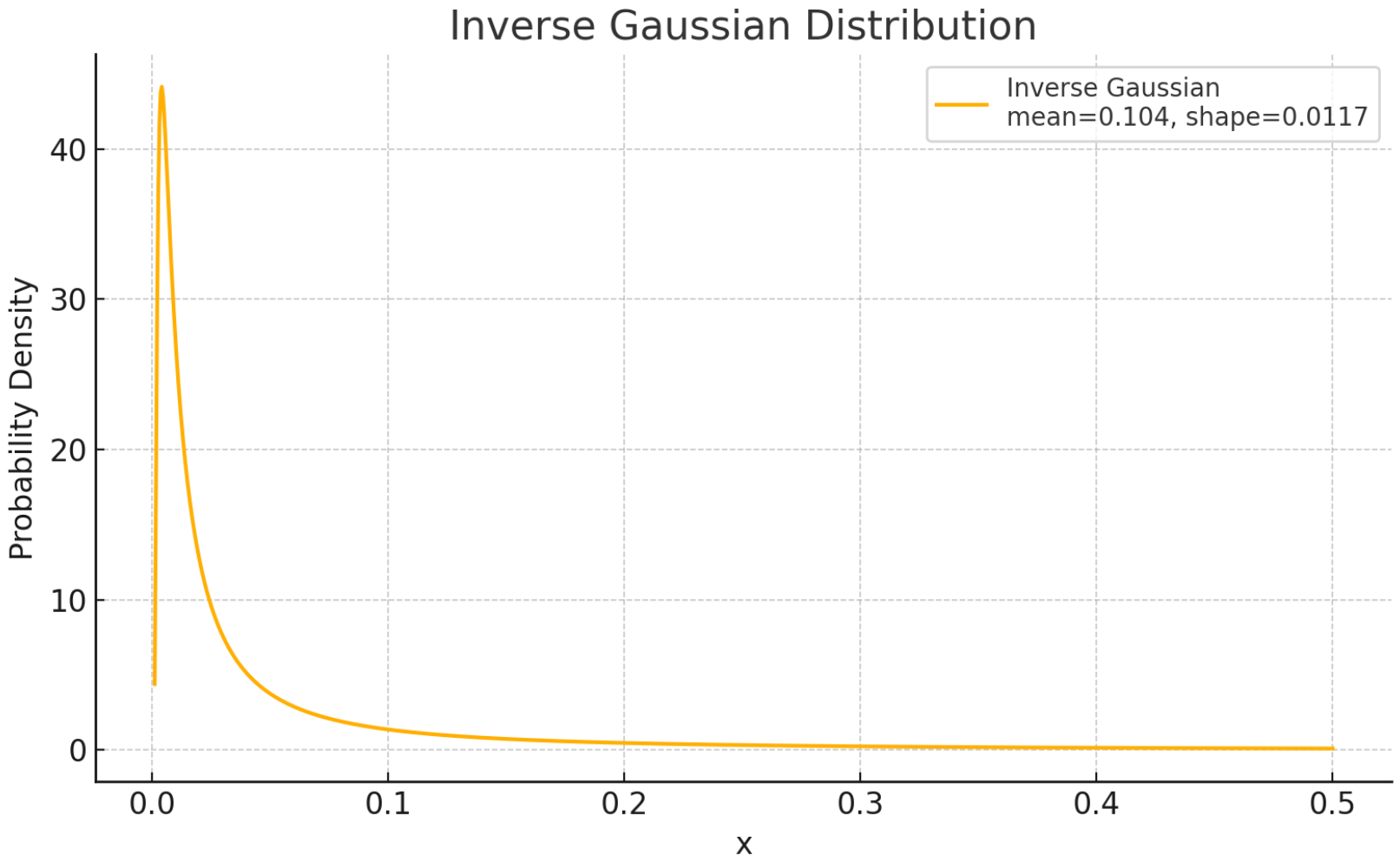
National Fire Sprinkler Association Fire Event Data (2014 – 2023, Multifamily Dwelling)

Door Closer Reliability

- New Zealand study used devices to record 180 days of data from 52 doors in four different sleeping occupancies (hotels, apartments, dorm, rest homes)
- 5 exit stair doors tested (not dwelling unit doors) in 2 apartment buildings
- Door reliability for *apartments / condos* in closed position:
  - Mean = 0.86

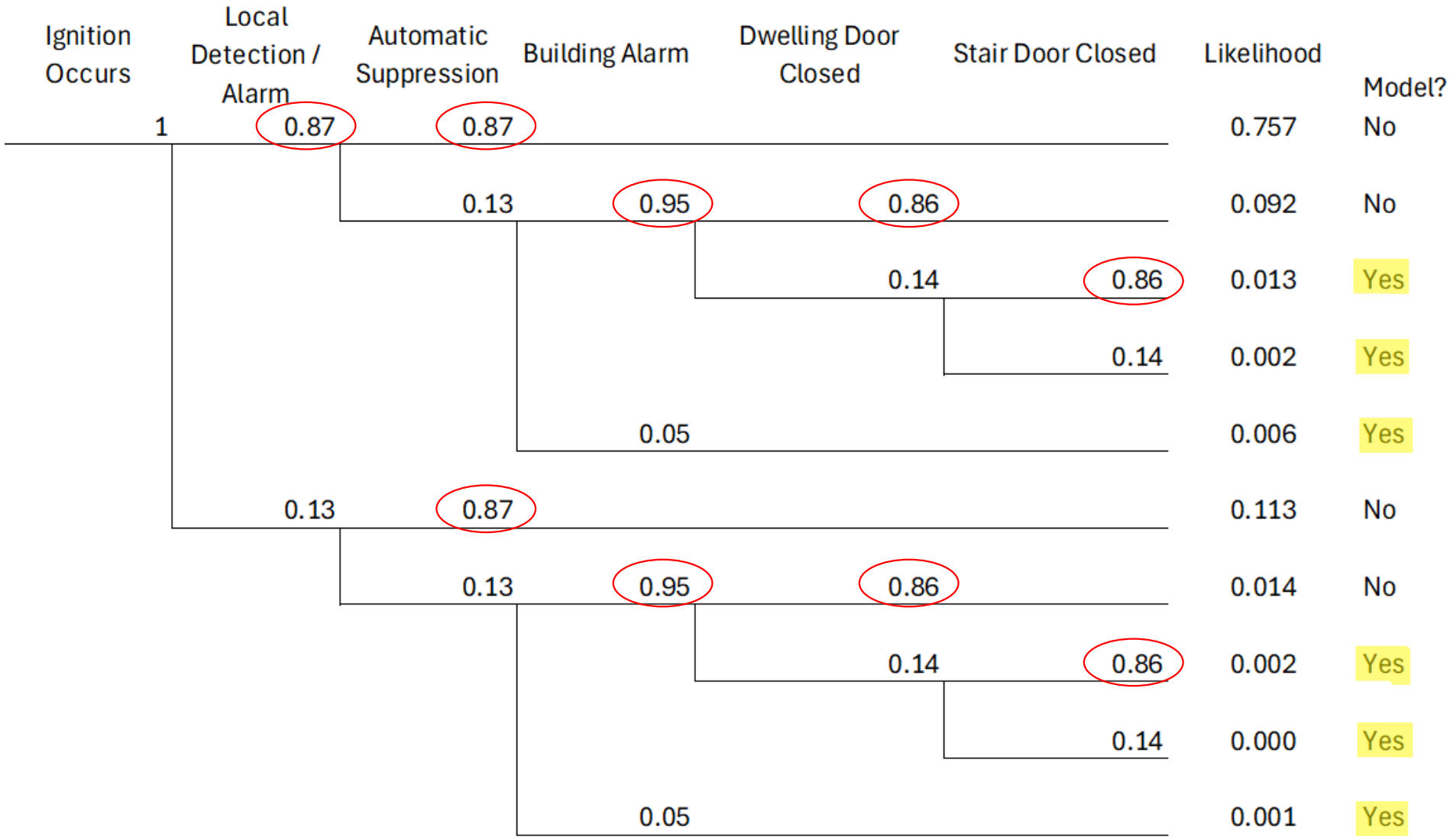
Finding the Probability of Doors Being Open Using a Continuous Position Logger, Kevin Frank, Michael Spearpoint, and Steve Weddell, University of Canterbury, 2014 International Association for Fire Safety Science

Door Closer Reliability For *All* Sleeping Occupancies



"Finding the Probability of Doors Being Open Using a Continuous Position Logger", Kevin Frank, Michael Spearpoint, and Steve Weddell, University of Canterbury, 2014 International Association for Fire Safety Science

Incorporating Data into the Event Tree



Mitigation with Lacking Reliability Data (To Date)

- Manual suppression by building occupants
- Dwelling door position
- Fire barrier
- Building construction type
- Elevator
- Building-wide fire alarm notification systems
- Fire rescue operation effectiveness
- Pressurization systems / smoke evacuation
- Inspection, testing, and maintenance

Equipment Reliability Takeaways

- Breadth and depth of data reviewed
- Minnesota sprinkler and detector systems trend higher than national averages
- Data availability varies by type of mitigation measure
- Adequate data to perform comparative risk analysis

DEPARTMENT OF LABOR AND INDUSTRY

Model Floor Plans

Nicholas Ozog | Wiss, Janney, Elstner Associates, Inc.

Overstory - Recap

- No building can ever be considered risk free or 100% safe.
- A risk-informed approach, which considers fire loss data, fuel loading, and system efficacy and reliability data is also critical to developing appropriate scenarios for fire effects modeling and evacuation modeling.
- Obtain consensus on what needs to be studied further.
- Continue to listen and learn from you.

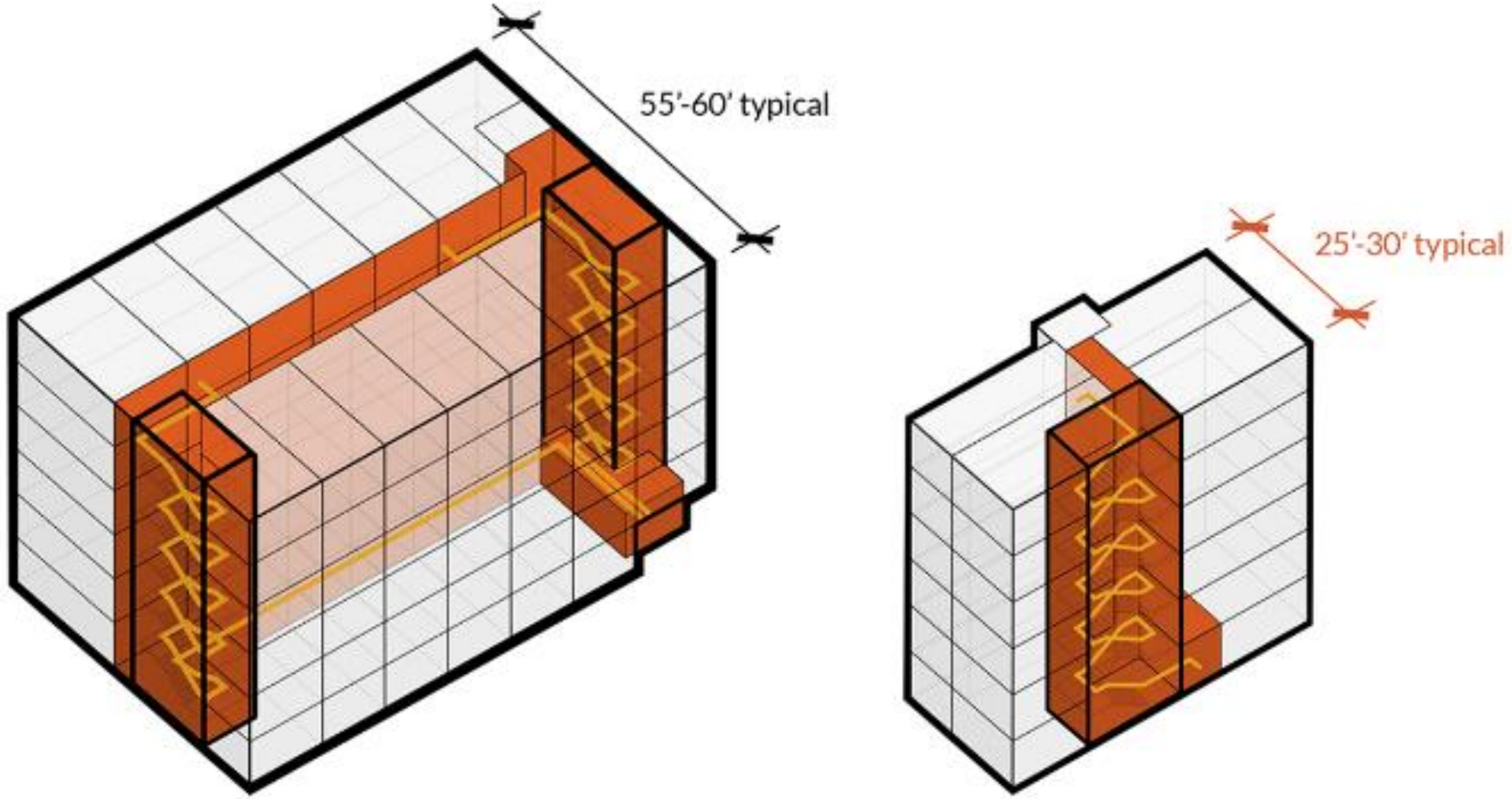
Housing Information

- Floor Area
  - Studio = 457 SF
  - One Bedroom = 735 SF
  - Two Bedroom = 1,097 SF
  - Three Bedroom =1,336 SF
- National Average = 908 SF
- Average for St. Paul MN = 761 SF
- Average for Minneapolis MN = 766 SF

- Approximate Percent of New Apartments By Unit Type in the Last Ten Years:
  - Studios = 5.1%
  - One Bedroom = 48.2%
  - Two Bedroom = 38.3%
  - Three Bedroom = 6.6%

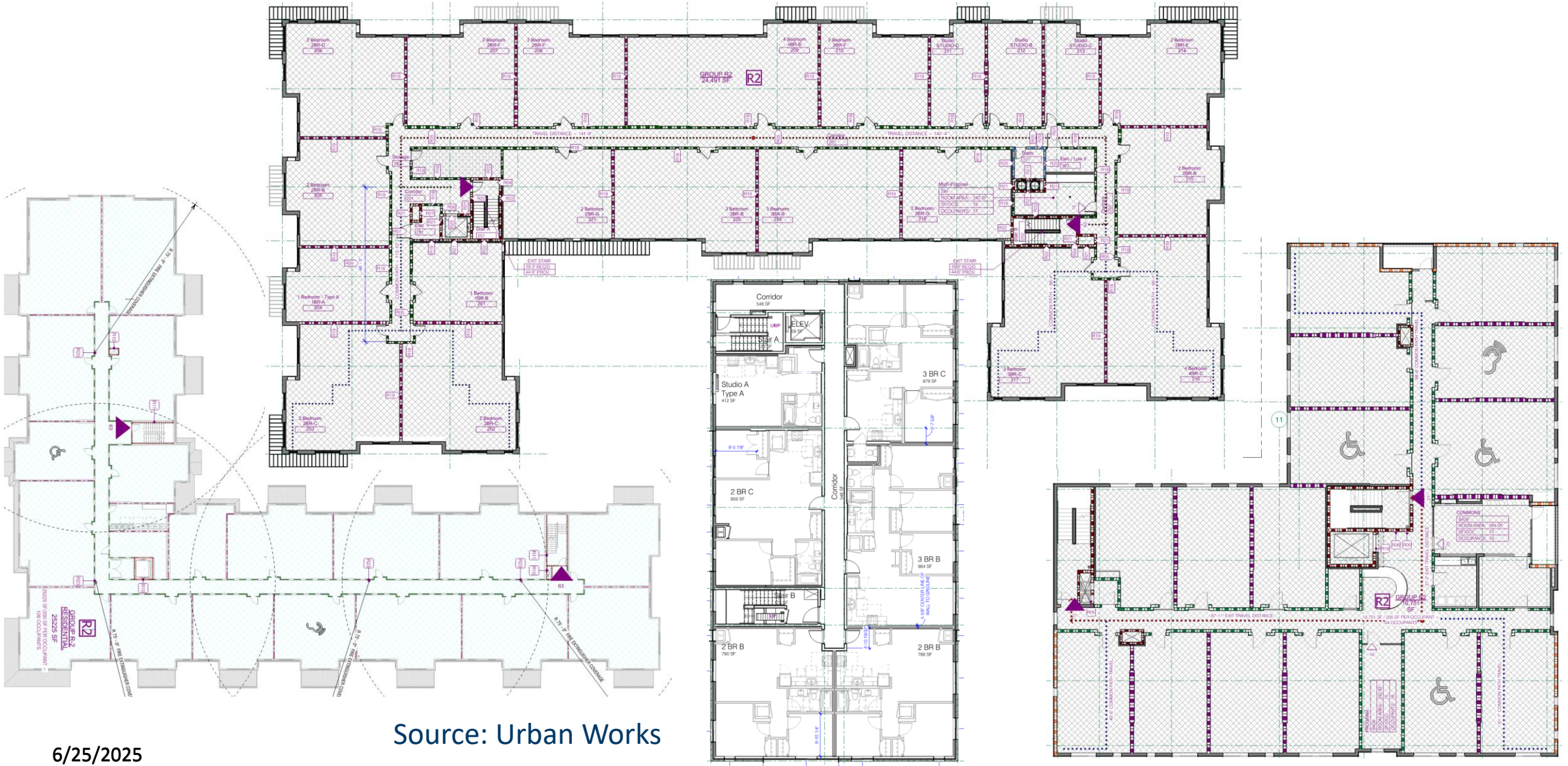
Source: https://www.rentcafe.com/

General Floor Plan Observations



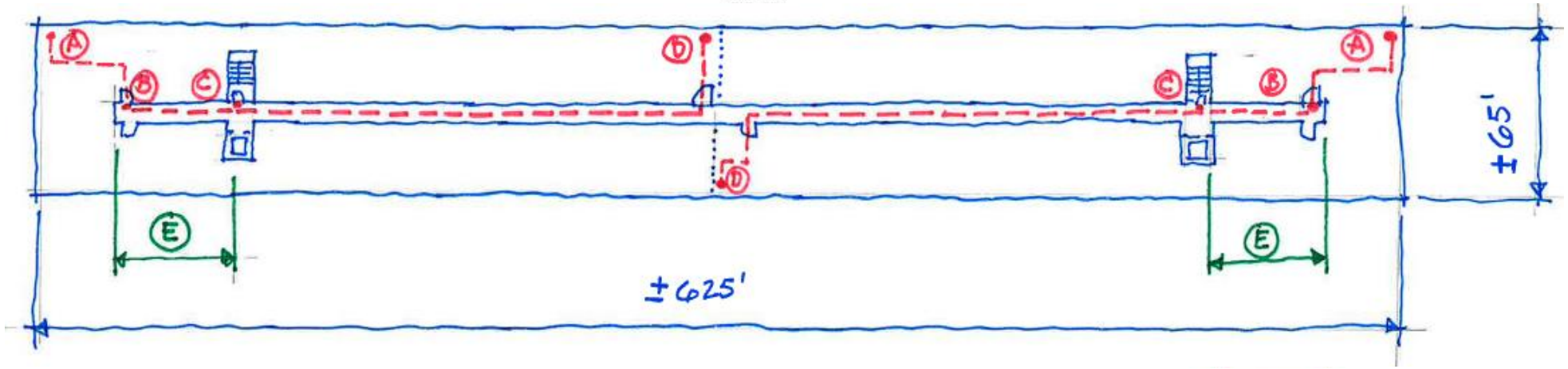
Source: SAR+ Architects via 2025 The Pew Charitable Trusts “Small Single-Stairway Apartment Buildings Have Strong Safety Record”

General Floor Plan Observations



Source: Urban Works

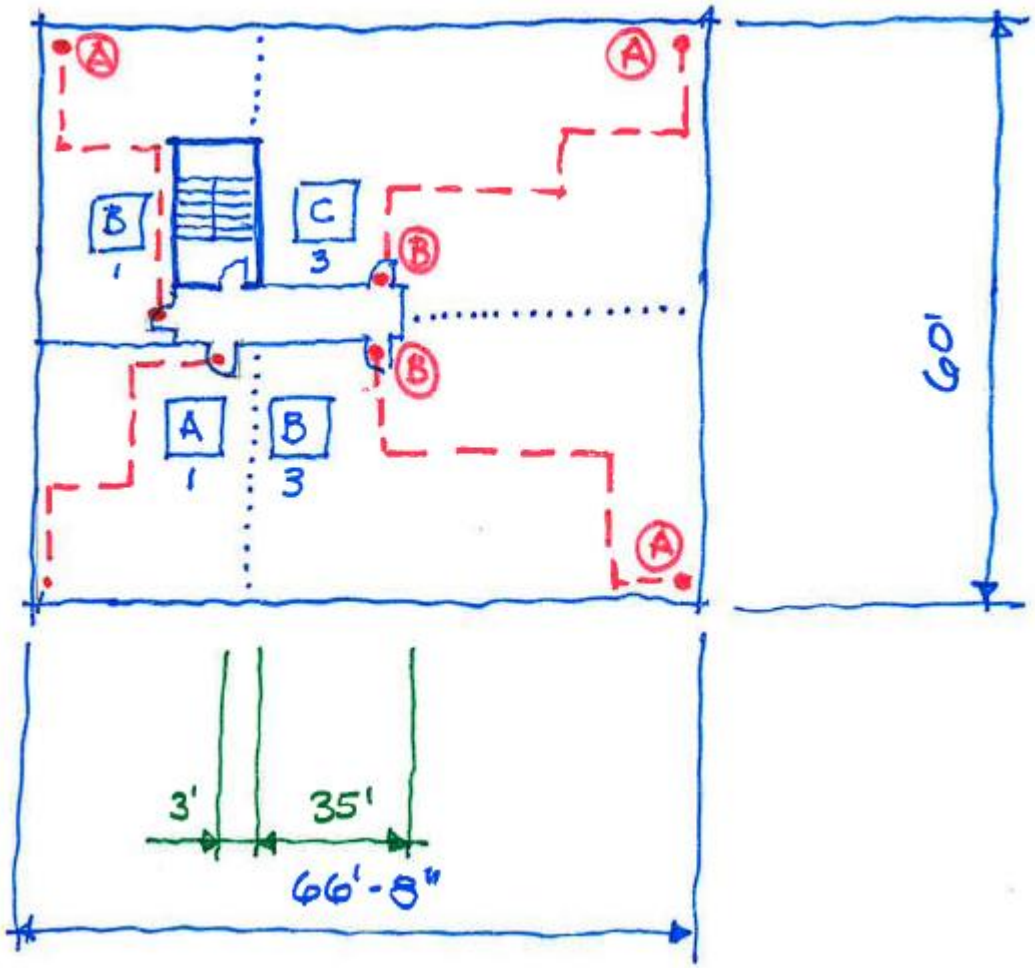
Layout ID 1: Two Exit Stair Building Floor Plan



Source: Center for Building in North America

- Floor Plan: 40,625 SF – 8 stories
- Travel Distance (250 FT)
- Common Path (125 FT)
- Dead End (50 FT)
- Number of Units: No Limit
- Unit sizing may vary

Layout ID 2: Single Exit Stair Building Floor Plan



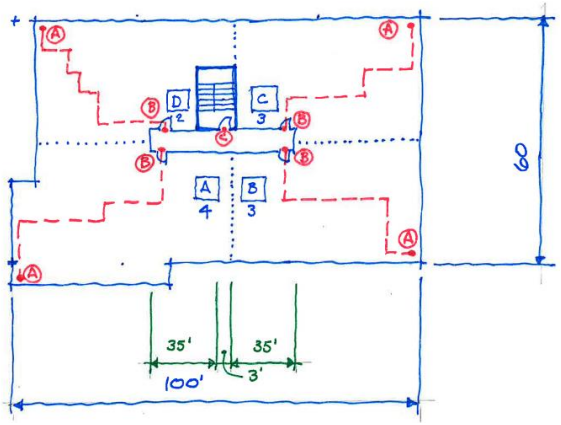
- Floor Plan: 4,000 SF – 3 stories
- Travel Distance (125 FT)
- Corridor Travel (35 FT)
- Number of Units (Limit 4)
- Unit sizing may vary
  - A and B: Studio/1 BDRM
  - C and D: 3 BDRM

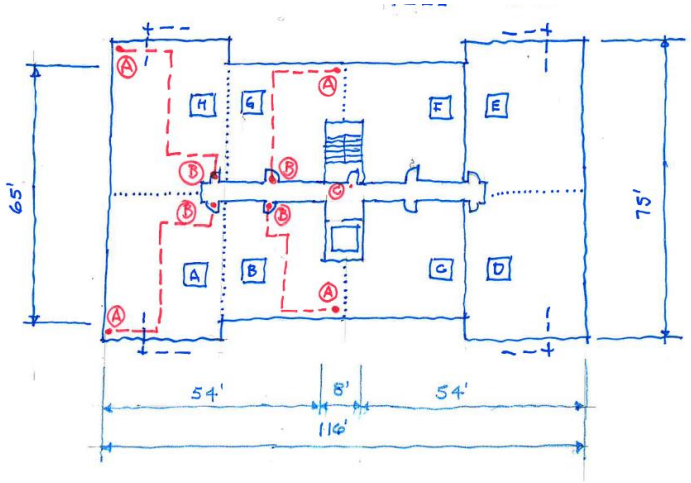
Variables Discussed

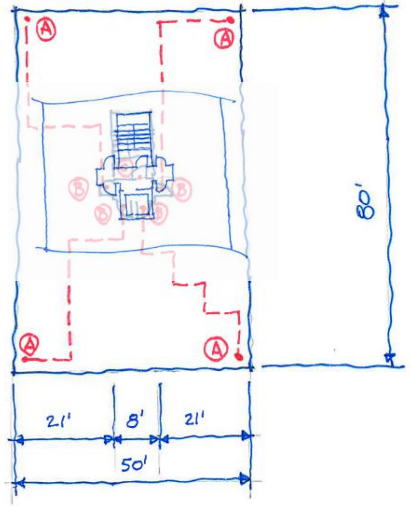
- **Floor Area**
- **Number of Stories**
- **Elevator**
- **Number of Dwelling Units**
- **Stair Width**
- Fire Location
- Fire Scenario
- Dwelling Unit Door Location
- Sprinkler Operation
- Dead End Distance
- Corridor Fire Resistance Rating
- Stair Fire Resistance Rating
- Compartmentation (Other)
- Construction Type
- Common Area Electrical Outlets
- Other Occupancies
- Details of Fire Alarm System (Notification)
- Emergency Escape and Rescue Openings
- Smoke Control Systems
- Travel Distance / Common Path

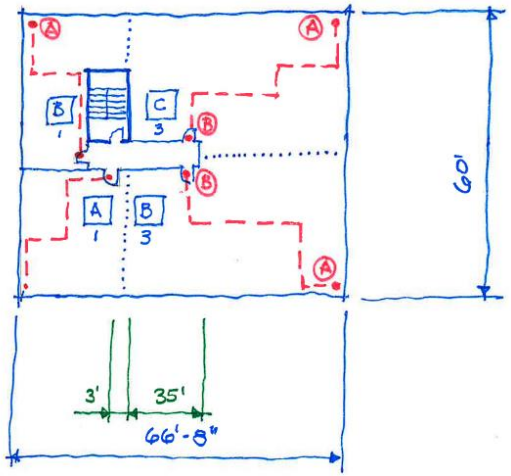
Layout ID 3: Single Exit Stair - Input from TAG

- Square footage:
  - **6,000 SF**
- Number of stories:
  - **8 stories**
- Elevator: **Yes**
- Number of dwelling units per floor:
  - **8 units**
- Stair width:
  - **48 inches**









DEPARTMENT OF LABOR AND INDUSTRY

Modeling

Nicholas Ozog | Wiss, Janney, Elstner Associates, Inc.

Fire Modeling Scenarios (No Sprinkler Intervention)

Model ID	Floor Plan	Number of Stories (Up to 75 ft in Building Height)	Living Room Fire		Corridor Fire	
			Dwelling Unit Door Position[1]	Stair Door Position[2]	Dwelling Unit Door Position	Stair Door Position[2]
1	2-Exit Stair (Allowed)	8?	Open	Closed	Closed	Closed
				Open		Open
2	1-Exit Stair (Allowed)	3	Open	Closed	Closed	Closed
				Open		Open
3	1-Exit Stair (Floor Plan TBD)	8?	Open	Closed	Closed	Closed
				Open		Open

1. Dwelling unit of fire origin
2. Stair door on floor of fire origin

DEPARTMENT OF LABOR AND INDUSTRY

Next Steps

Nicholas Ozog | Wiss, Janney, Elstner Associates, Inc.

Next Steps

- Model floor plans from TAG Meeting No. 2
- Further investigation where data is lacking
- Define design fire scenarios using event tree
- Risk achievement worth (RAW) for system importances
- Prepare report for DLI

DEPARTMENT OF LABOR AND INDUSTRY

Thank You!

Nicholas Ozog
nozog@wje.com

Kyle Christiansen
kyle@cruxcon.com