

Fires that Commence on Balconies of Multi-Residential Buildings

Analysis of the National Fire Incident Database



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Executive Summary

The purpose of this study was to examine the significance of fires that occur on the exterior of multi-residential buildings. This research was motivated by the findings from previous work, that suggested there are existing vulnerabilities associated with fires that commence in external, recreational areas such as balconies and patios (6).

The data presented in this study was obtained from the National Fire Incident Information Data Base (NFID) assembled by Statistics Canada on behalf of the Canadian Association of Fire Chiefs and the Canadian Association of Fire Commissioners and Fire Marshalls.

The NFID database contains information on 439,256 fire incidents. Among those are 210,121 structure fire incidents where we can examine some key characteristics of those incidents (such as, fire spread and fire department intervention) as well as fire-related casualties (that is, deaths and persons injured) resulting from incidents. In total, 1,733 fire-related deaths (10 were firefighters) and 12,503 persons injured (1,956 were firefighters) were reported in structural fires over the ten-year period covered by the data.

Data was provided by the National Fire Information Database (NFID) and included all multi-residential in the Provinces of British Columbia, Alberta, Saskatchewan, Manitoba, Ontario and New Brunswick from fires reported to the Database between 2005 and 2015.

From a total of 210,121 structure fires that were reported, 27,386 fires (13%) that occurred in multi-residential buildings were retained for this analysis.

Overall, 10% of the multi-residential building fires originated from an outside area (either the exterior balcony (including open porch or deck) or court/patio/terrace area). The percentage matches a previous study conducted (6). There was one fatality recorded as having been associated with these outside-origin fires, and there was lower frequency of injury associated with outside fires (in relation to all others). The damage associated with outside fires was 2.8 times greater than the average loss associated with all other multi-residential structure fires.

There is clear indication that there is a vulnerability associated with fires that commence on the exterior of multi-residential buildings, in relation to all other fires. The analysis revealed that relative to the remainder of the multi-residential structure fires examined, fires that commenced on the building exterior were:

- 4.7 times less likely to activate a smoke alarm and 1.6 times more likely to require visual sighting of some other means of personal detection.
- 1.8 times more likely to require the fire department to apply water and 1.2 times more likely to have been controlled by makeshift firefighting aids.
- 4.3 times less likely to have burned out on their own, and 4.5 times less likely to have been controlled by sprinkler systems.

- 1.1 times less likely to be contained to at least the room of origin of the fire, over 2 times more likely to extend as far as the building of origin, and 2 times more likely to extend beyond the property of origin.

These vulnerabilities should be ameliorated to an extent by the recent amendments to the National Building Code that mandate additional fire protection for mid-rise, multi-residential buildings, including (but not restricted to) sprinklers on balconies, fire-resistant exterior cladding, and additional fire separations in roof areas.

In addition to these measures, however, it is worth exploring the fire safety implications of re-thinking the recreational use of propane appliances on balconies and the significance of unplanned fuel loads in these areas as a result of them being used for storage. Keeping in mind these legitimate uses for these areas of the buildings, it is worth considering enhancing the fire protection systems in place on balconies and common recreational by either (a) prohibiting storage in these areas, (b) providing strategies for early detection of fire events, or (c) extending sprinkler protection to cover these areas, where possible, (d) or implement fire resistant materials for new and existing structures that could prevent the fire spread.

Whichever combination of techniques are selected, reducing the exposure to these vulnerabilities needs a systems approach (involving the building resident, the building responsible person, the built-in fire protection strategies, the insurance industry, and the fire service) and must operate within a realistic framework about legitimate use, storage requirements, and costs of fire protection improvements.

Background and Purpose of this Research

Recent research into the significance of sprinkler systems for fire outcomes [1, 2] and the fire implications for the storage/use of propane in multi-residential buildings [3, 6] has raised concerns that fires that occur on the exterior of multi-residential buildings expose vulnerabilities in existing fire safety strategies and systems. This study summarizes the findings from a retrospective analysis of National Fire Information Database (NFID) that reported multi-residential fire incident data in five jurisdictions in Canada and examines how the built-in fire protection systems have performed historically when confronted with fires in multi-residential buildings that commence on the building exterior.

Identifying Relevant Cases for Analysis

Data was provided by the National Fire Information Database (NFID), including all fires between 2005 and 2015. The overall data set of 210,121 structure fires was sorted and incidents were retained for analysis if they had occurred in an apartment, tenement, flat, townhouse, or

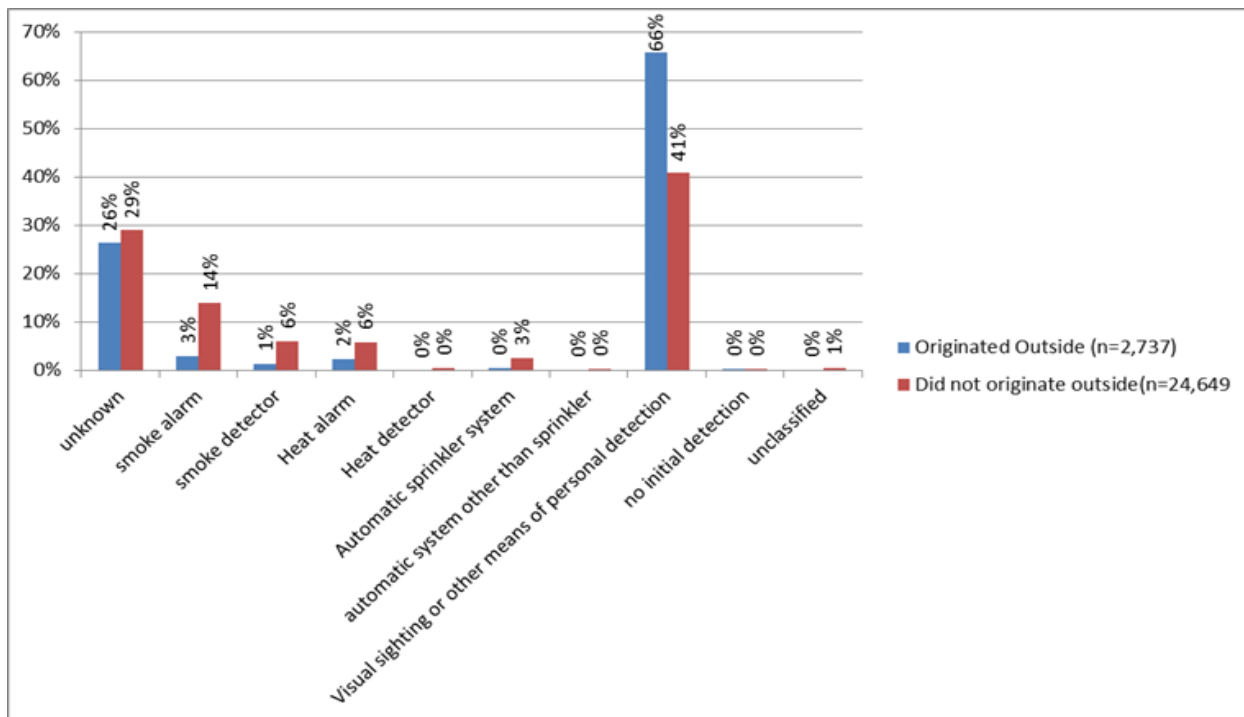
condominium¹ and fires were classified as originating outside if they were identified as having started on an exterior balcony (including open porch or deck) or a court/patio/terrace area.²

Table 1 demonstrates the number of multi-residential structure fires, the number of fire-related deaths and injuries, and the estimated average property loss associated with each fire. Overall, 10% of the fires that were reported in multi-residential buildings originated from the outside area. With respect to fire-related fatalities, there was one fatality that resulted from fires that originated outside the building. The injury rate per 1,000 fires was lower for fires that originated outside (57.4 injuries) compared to the remainder of the fires (132.4 injuries)³. Interestingly, however, the difference between the estimated property losses (in dollars) as a result of fire origin indicated that the damage as a result of fires that originated outside the multi-residential buildings was 3.8 times greater than for damage caused by all other multi-residential fires.⁴

HOW THE FIRE WAS INITIALLY DETECTED BY AREA OF ORIGIN

Figure 1 shows the process by which multi-residential structure fires were initially detected as a function of the area of origin for the fire. As can be seen, the fires that occurred on the outside of these multi-residential buildings were 4.7 times less likely to be detected as a result of an activated smoke alarm and 1.6 times more likely to require visual sighting of some other means of personal detection. These patterns have obvious implications for the typical built-in fire protection systems in these buildings, exposing a gap in the monitoring coverage typically provided by smoke alarms.

FIGURE 1: PROCESS OF INITIAL DETECTION FOR FIRES IN MULTI-RESIDENTIAL BUILDINGS AS A FUNCTION OF AREA OF FIRE ORIGIN



¹ Property classification values: PR3210, PR3220, PR3230, PR3240, PR3250, and PR3290.

² Fire origin area values: OA7200 = exterior balcony and OA9200 = court/patio/terrace.

³ Rate-ratio difference here was significant, $t = -2.9534$, $df = 559.93$, $p\text{-value} = 0.001637$

⁴ Rate-ratio difference here was significant $t = 1.7474$, $df = 370.29$, $p\text{-value} = 0.0407$

METHOD OF FIRE CONTROL BY AREA OF ORIGIN

Figure 2a displays the relative frequencies at which a range of methods of fire control were utilized to respond to these multi-residential structure fires, as a function of the fire area of origin. These patterns demonstrate that fires that commenced on the outside of multi-residential buildings were 1.8 times more likely to require the fire department to apply water and 1.2 times more likely to have been controlled by makeshift firefighting aids. In contrast, these external fires were also 4.3 times less likely to have burned out on their own, and 4.5 times less likely to have been controlled by sprinkler systems. If the frequencies are adjusted by removing the unknown category, the likelihood would be slightly changed but the conclusions remain the same (Figure 2b).

FIGURE 2A: METHOD OF FIRE CONTROL FOR FIRES IN MULTI-RESIDENTIAL BUILDINGS AS A FUNCTION OF AREA OF FIRE ORIGIN

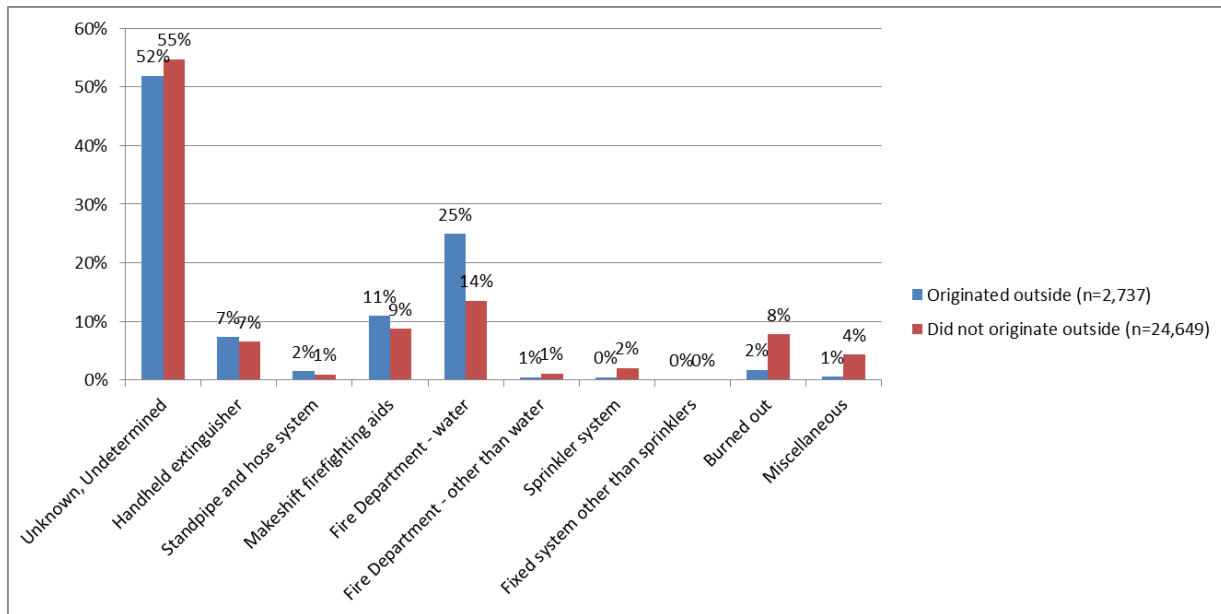
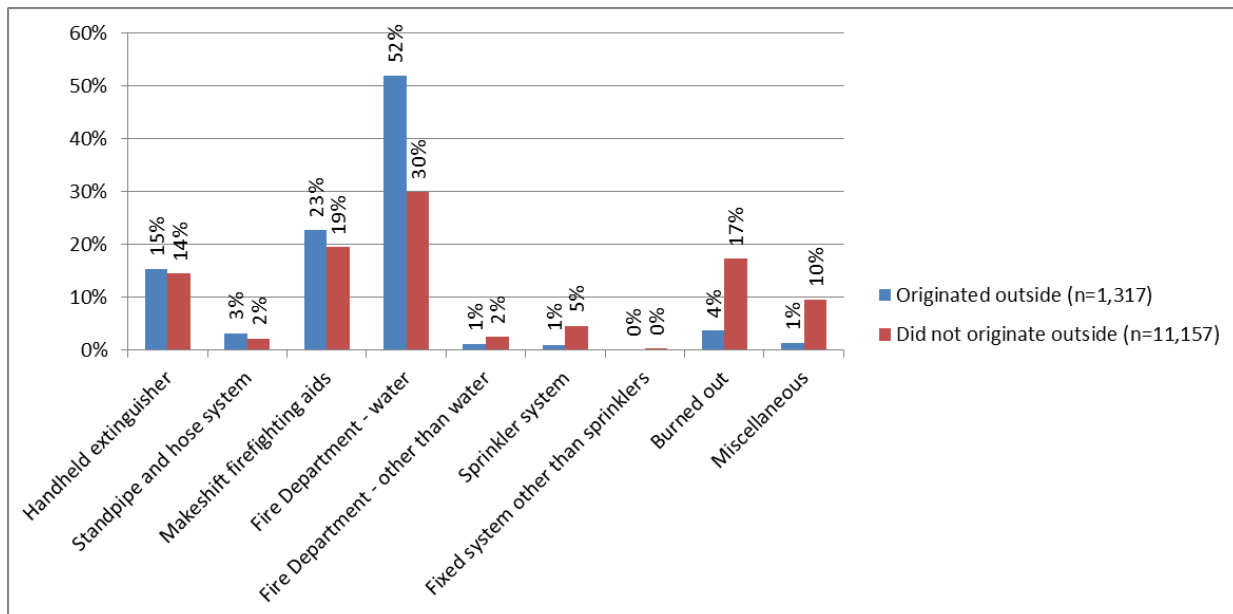


FIGURE 2B: METHOD OF FIRE CONTROL FOR FIRES IN MULTI-RESIDENTIAL BUILDINGS AS A FUNCTION OF AREA OF FIRE ORIGIN - EXCLUDING UNKNOWN CATEGORY



SPREAD OF FIRES BY AREA OF ORIGIN

The relative extent to which these multi-residential structure fires spread is displayed in Figure 3a as a function of the fire area of origin. Despite some variations in the relative percentages at which fires were confined to the object, part of room, and room of origin as a function of the area of fire origin, when these percentages are combined to examine how often fires were confined to at least the room of origin it revealed that outside origin fires were 1.1 times less likely to be contained to this level (52% for outside fires vs. 54% for the rest of the incidents). In contrast, the fires that originated outside were over 2 times more likely to extend as far as the building of origin and 2 times more likely to extend beyond the building of origin, relative to the remainder of the multi-residential structure fires examined. If the percentages are adjusted by removing the unknown category, the likelihood would be slightly changed but the conclusions remain the same (Figure 3b)

FIGURE 3A: EXTENT OF FIRE SPREAD FOR FIRES IN MULTI-RESIDENTIAL BUILDINGS AS A FUNCTION OF AREA OF FIRE ORIGIN

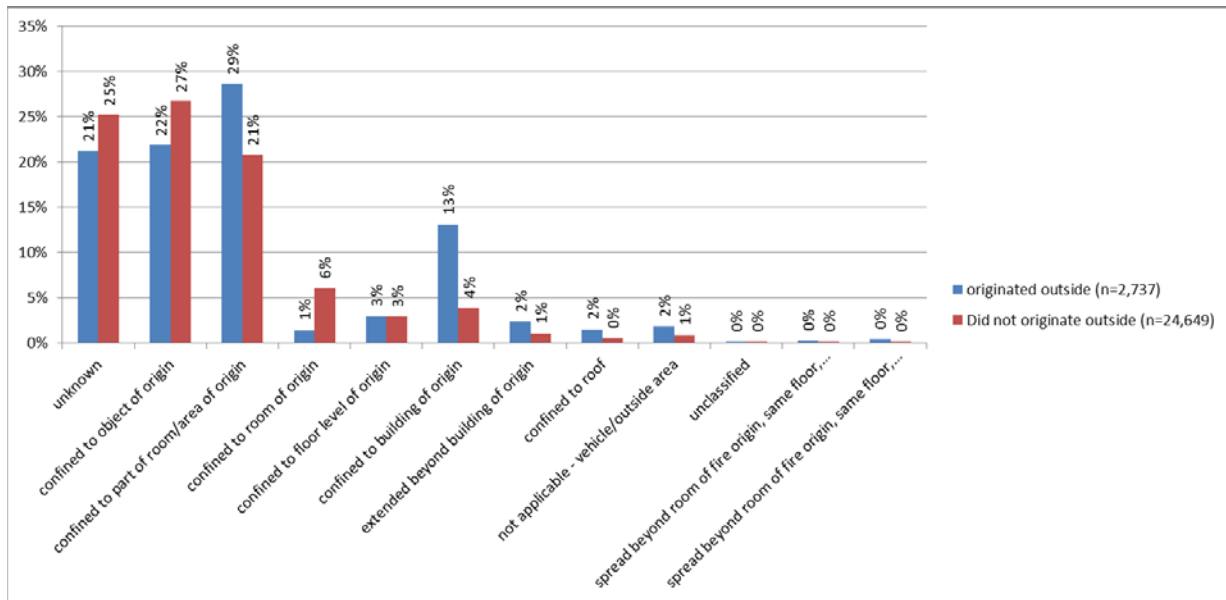
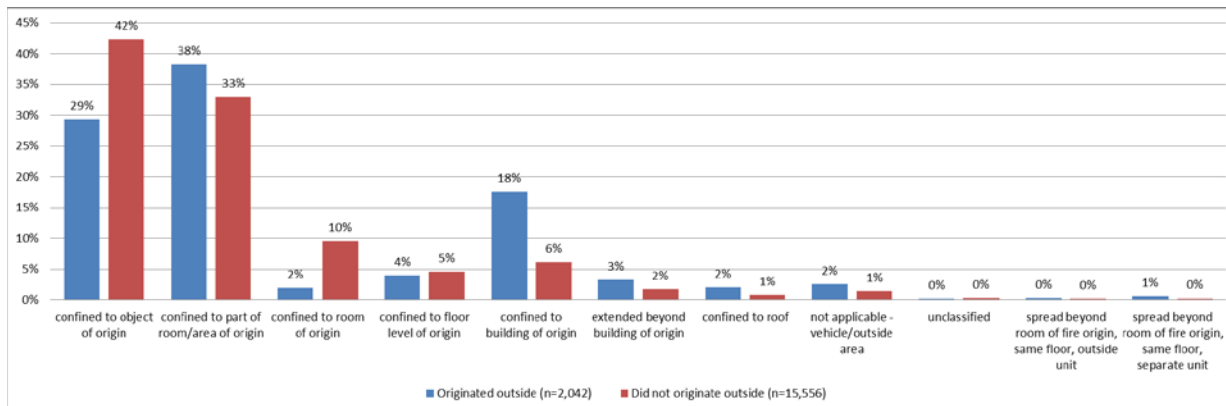


FIGURE 3B: EXTENT OF FIRE SPREAD FOR FIRES IN MULTI-RESIDENTIAL BUILDINGS AS A FUNCTION OF AREA OF FIRE ORIGIN - EXCLUDING UNKNOWN CATEGORY



Discussion and Conclusions

In summarizing these findings, fires that commenced on the exterior of these multi-residential buildings were:

- Less likely to activate a smoke alarm and more likely to require visual sighting of some other means of personal detection.
- More likely to require the fire department water application.
- Less likely to have burned out on their own and less likely to have been controlled by sprinklers.
- More likely to extend as far as the building of origin and beyond.

These vulnerabilities should be ameliorated to an extent by the recent amendments to the National a Building Code that mandate additional fire protection for new mid-rise, multi-residential buildings, including (but not restricted to) sprinklers on balconies (to additional code levels required under NFPA 13), fire-resistant exterior cladding, and additional fire separations in roof areas [4].

In addition to these measures, however, it is worth exploring the fire safety implications of re-thinking the recreational use of propane appliances on balconies and the significance of unplanned fuel loads in these external areas as a result of them being used for storage. Keeping in mind these legitimate uses for these areas of the buildings, it is worth considering enhancing the fire protection systems in place on balconies and common recreational by either:

- a) Prohibiting storage in these areas;
- b) Providing strategies for early detection of fire events;
- c) Extending sprinkler protection to cover these areas, where possible, or;
- d) Imposing fire resistant materials in new and existing structures that could prevent fire spread.

Whichever combination of techniques are selected, reducing the exposure to these vulnerabilities needs a systems approach (involving the building resident, the building responsible person, the built-in fire protection strategies, and the fire service) [5] and must operate within a realistic framework about legitimate use, storage requirements, and costs of fire protection.

References

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