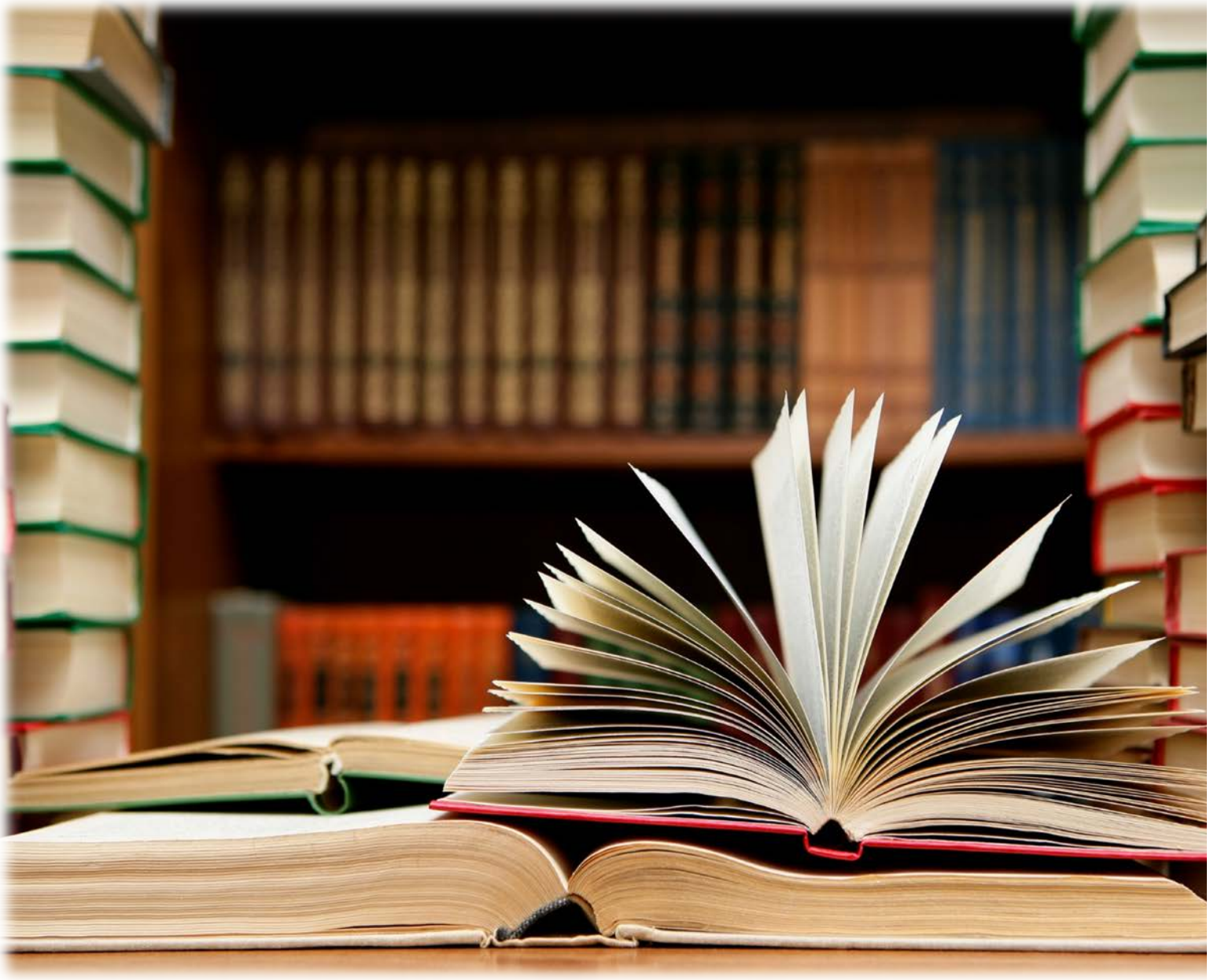
Fires that Commence on Balconies of Multi-Residential Buildings

The Importance of an External Fire Area of Origin for Residential Fire Outcomes



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UNIVERSITY OF THE FRASER VALLEY
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Executive Summary

1. 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 of previous investigations into sprinkler systems and the storage of propane in these types of buildings, which suggested there are existing vulnerabilities associated with fires that commence in external, recreational areas such as balconies and patios.

2. Data was provided by the British Columbia Office of the Fire Commissioner and included all fires reported to the Office between October 2006 and October 2011. From a total of 37,942 fires that were reported, 2,638 fires that occurred in multi-residential buildings were retained for this analysis.

3. Overall, 9.7% 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). There were no fatalities recorded as having been associated with these outside-origin fires, and there was no difference in the frequency of injury associated with outside fires (in relation to all others). The damage associated with outside fires was 2.4 times greater than the average loss associated with all other multi-residential structure fires.

4. 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:

    a) 5.5 times less likely to activate a smoke alarm and 1.4 times more likely to require visual sighting of some other means of personal detection.

    b) 1.5 times more likely to require the fire department to apply water and 1.5 times more likely to have been controlled by makeshift firefighting aids.

    c) 3.3 times less likely to have burned out on their own, 5.4 times less likely to have been controlled by the removal or shut-off of the fuel supply, and 3.5 times less likely to have been controlled by sprinkler systems.

    d) 1.1 times less likely to be contained to at least the room of origin of the fire, 1.9 times more likely to extend as far as the building of origin, and 4.1 times more likely to extend beyond the property of origin.

5. These vulnerabilities should be ameliorated to an extent by the recent amendments to the British Columbia 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.

6. In addition to these measures, however, it is worth exploring the fire safety implications of re-thinking the recreational use of propane 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. 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) and must operate within a realistic framework about legitimate use, storage requirements, and costs of fire protection.

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] has raised concerns that fires that occur on the exterior of multi-residential buildings expose vulnerabilities in existing fire safety strategies and systems. This research note summarizes the findings from a retrospective analysis of five-years of fire incident data reported in British Columbia (BC) examining 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 BC Office of the Fire Commissioner (OFC), including all fires reported to the OFC between October 2006 and October 2011. The overall data set of 37,492 fires was sorted and incidents were retained for analysis if they had occurred in an apartment, tenement, flat, townhouse, or condominium[1] 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 BC reporting areas that provided data, along with 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, 9.7% of the fires that were reported in multi-residential buildings originated from the outside area. With respect to fire-related fatalities, there were none that resulted from fires that originated outside the building. The injury rate per 1,000 fires was equivalent for fires that originated outside (70.6 injuries) compared to the remainder of the fires (89.4 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 2.4 times greater than for damage caused by all other multi-residential fires.[4]

TABLE 1. FREQUENCY OF STRUCTURE FIRES, DEATHS, INJURIES, AND AVERAGE LOSS ($) FOR FIRES IN MULTI-RESIDENTIAL BUILDINGS AS A FUNCTION OF AREA OF FIRE ORIGIN

Area of origin for the fire	# Reporting locations	# Fires	# Deaths	# Injuries	Avg. $ loss*
Originated outside	44	255	0	18	$138,376
Did not originate outside	102	2,383	36	213	$58,016
Total	**106**	**2,638**	**36**	**231**	**$80,348**

* Missing values were excluded from this average loss calculation, resulting in outside n = 241 and not outside n = 2,318.

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 5.5 times less likely to be detected as a result of an activated smoke alarm and

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

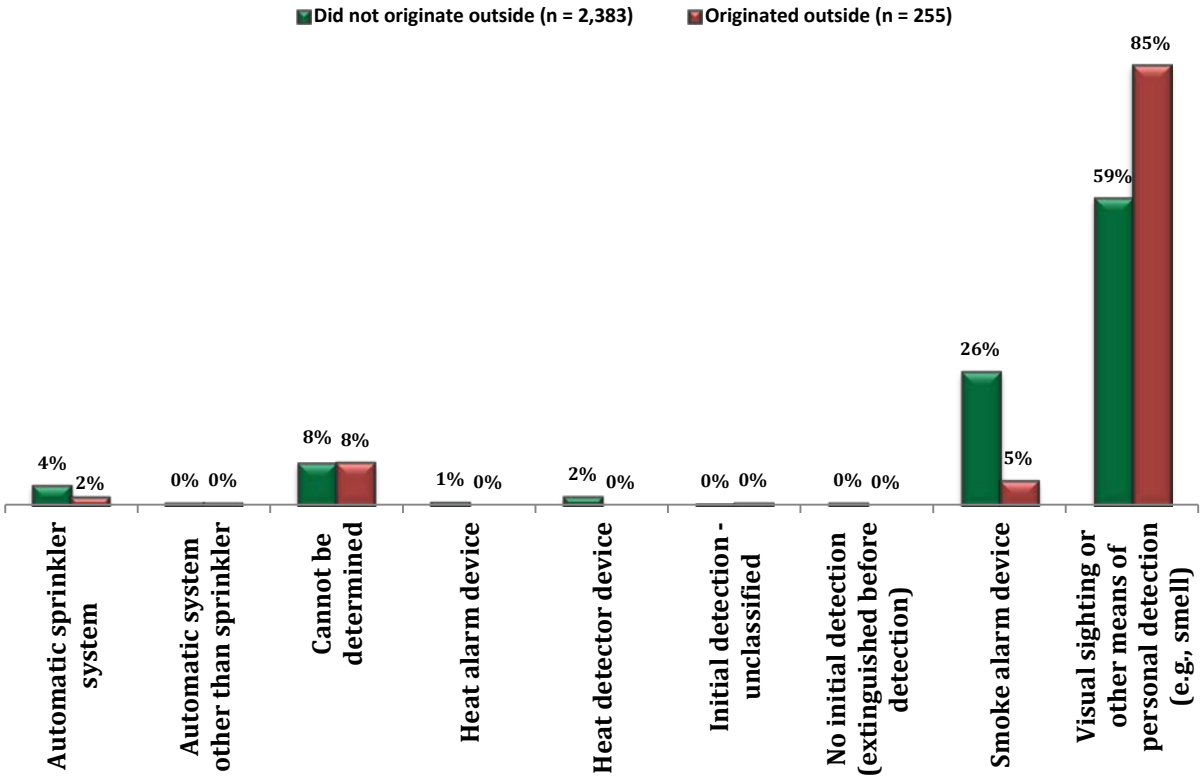
[2] Fire origin area values: OA7200 = exterior balcony and OA9200 = court/patio/terrace.

[3] Rate-ratio difference here was non-significant, $Z = -0.96$, $p > .10$.

[4] Significant independent samples t-test: t (df = 2,557) = 2.10, $p < .04$.

1.4 times more likely to require visual sighting of some other means of personal detection.[5] 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

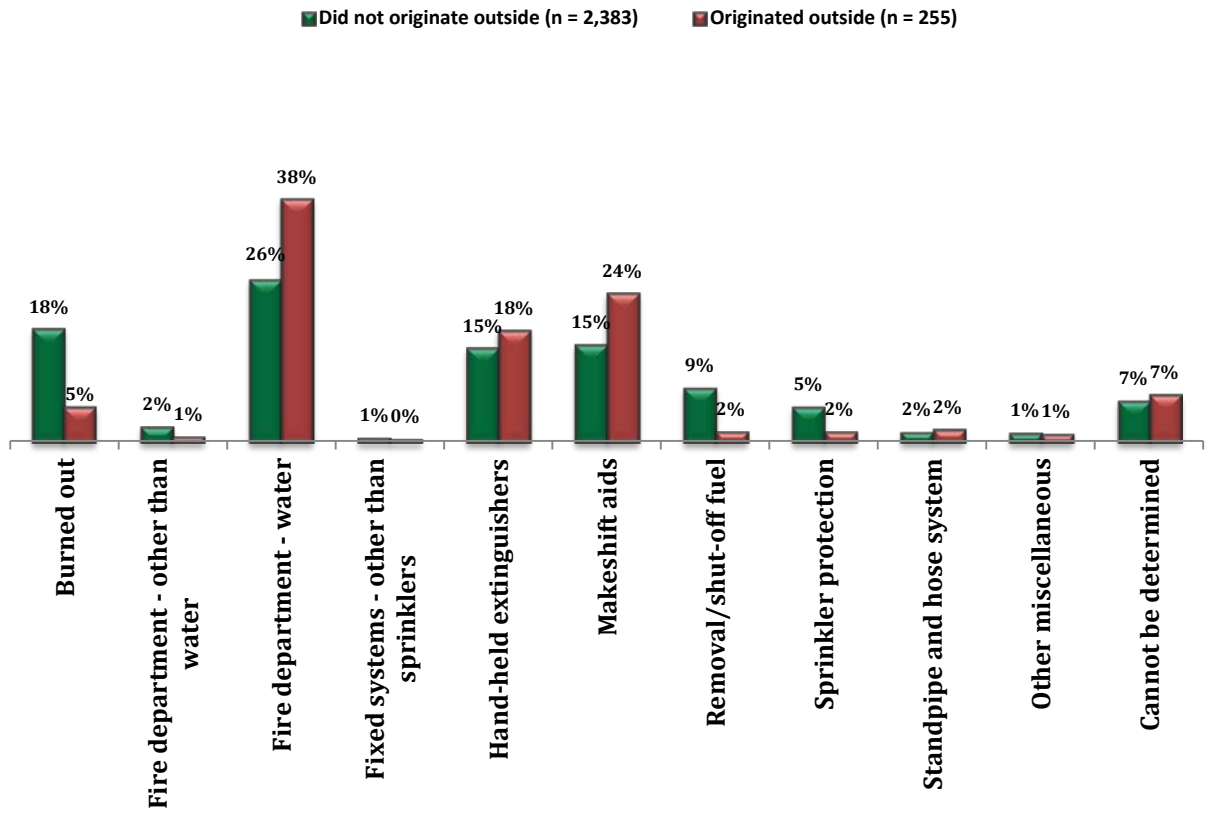


Method of Fire Control by Area of Origin

Figure 2 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 1.5 times more likely to require the fire department to apply water and 1.5 times more likely to have been controlled by makeshift firefighting aids. In contrast, these external fires were also 3.3 times less likely to have burned out on their own, 5.4 times less likely to have been controlled by the removal or shut-off of the fuel supply, and 3.5 times less likely to have been controlled by sprinkler systems.

[5] All differences discussed here were significant, with planned comparisons returning *Z*'s > |1.96|.

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

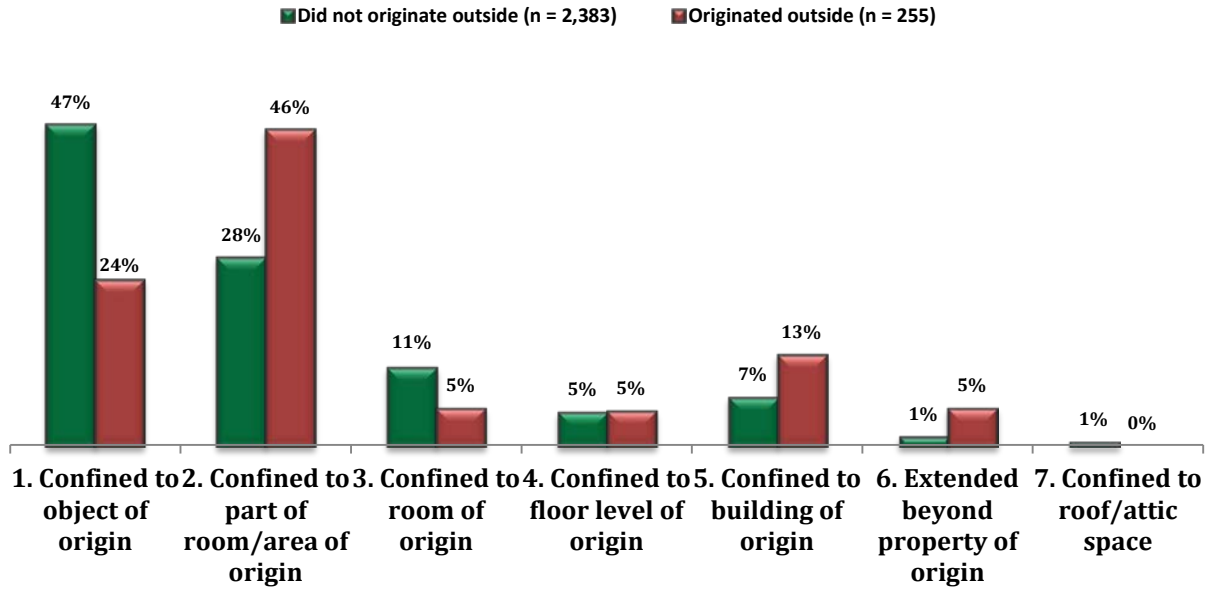


Spread of Fires by Area of Origin

The relative extent to which these multi-residential structure fires spread are displayed in Figure 3 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 (76.1% for outside fires vs. 86.1% for the rest of the incidents). In contrast, the fires that originated outside were 1.9 times more likely to extend as far as the building of origin and 4.1 times more likely to extend beyond the property of origin, relative to the remainder of the multi-residential structure fires examined.[6]

[6] All differences discussed in this paragraph were significant, with planned comparisons returning *Z*'s > |1.96|.

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



Discussion and Conclusions

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

a) Less likely to activate a smoke alarm and more likely to require visual sighting of some other means of personal detection.

b) More likely to require the fire department water application.

c) Less likely to have burned out on their own, less likely to have been controlled by the removal/shut-off of fuel, and less likely to have been controlled by sprinklers.

d) 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 British Columbia 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 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; or

c) Extending sprinkler protection to cover these areas, where possible.

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

[1] L. Garis and J. Clare, *Sprinkler systems and fire outcomes in multi-level residential buildings*, 2012, Centre for Public Safety and Criminal Justice Research, School of Criminology and Criminal Justice, University of the Fraser Valley.

[2] L. Garis and J. Clare, *Sprinkler systems and residential structure fires: exploring the impact of sprinklers for life safety and fire spread*, 2013, Centre for Public Safety and Criminal Justice Research, School of Criminology and Criminal Justice, University of the Fraser Valley.

[3] J. Armstrong, J. Clare, and L. Garis, *Propane-fuelled vehicles and multi-residential building storage risk: examining the frequency of propane-fuelled structure and vehicle fires*, 2013, Centre for Public Safety and Criminal Justice Research, School of Criminology and Criminal Justice, University of the Fraser Valley.

[4] Office of Housing and Construction Standards. *Mid-rise wood frame | Building Provisions*. [cited 2011 3 November]; Available from: http://www.housing.gov.bc.ca/building/wood_frame/6storey_form.htm.

[5] Manitou Incorporated, *Surrey Fire Service high-rise fire service study, City of Surrey, British Columbia - Final Report*, 2008, Manitou, presented to Fire Chief Len Garis: New York. p. 47.

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