Seismic Risk in Canada

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NRCan's Risk Team

(includes Seismic Hazard, Indigenous Engagement Network, Earthquake Seismology, etc.)



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Seismic Hazard & Site Response



Wald & Allen, 2007; USGS



Exposure Model



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Representative inventory, includes construction material, seismic design level (code) and occupancy type;

Recently published as:

Journeay, J.M., LeSueur, P., Chow, W., and Wagner, C. (2022). *Physical exposure to natural hazards in Canada*. Geological Survey of Canada, Open File, 8892:95p. doi 10.4095/330012.



Simulated Effect of Retrofit

- Assume all buildings could be brought to around 60-80% of the current code
- Exception for unreinforced masonry (low code)
- Exception for post-disaster buildings (high code)

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SSC-1. Assume Moderate-Code design for residential wood-frame buildings (W1). 2. Assume Low-Code design for residential wood-frame buildings (W1).

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Proposed Seismic Design Levels for Existing Buildings in Canada

eismic (SSC)	PGA (2%/50yr)	Sa0.2 (2%/50yr)	Sa1.0 (2%/50yr)	2005-present	1990-2004	1973-1989
5	>0.4	>=1.15	>=0.50	High-Code	High-Code	Moderate-Code
4	0.32-0.4	0.75-1.15	0.30-0.50	High-Code	Moderate-Code	Moderate-Code
3	0.24-0.32	0.35-0.75	0.15-0.30	Moderate-Code	Moderate-Code	Low-Code
2	0.16-0.24	0.20-0.35	0.10-0.15	Moderate-Code	Low-Code	Pre-Code ²
1	0.075-0.16	0.10-0.20	0.05-0.10	Low-Code	Low-Code	Pre-Code ²
0	0.05-0.075	<= 0.10	<=0.05	Low-Code	Pre-Code ²	Pre-Code ²





Social Vulnerability Model

• Recently published as:

Journeay, J., Yip, J., Wagner, C., LeSueur, P., and Hobbs, T. (2022b). Social vulnerability to natural hazards in Canada. **Geological Survey of** Canada, Open File, 8902:84p. doi 10.4095/330295.



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Fragility and Vulnerability



Ann Abraham (UBC Doctoral Graduate)

0.6 0.4

Probability of Exceedance 0.0 0.0 0.0 0.0 0.0 0.8

0.6

0.4

0.2

0.0

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SRIabsolute



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Average Annual Losses & Fatalities

City	AAL (Absolute)	AAL (Fraction of Total)	APLL (Absolute)	APLL (Fraction of Total)
Montreal, QC	\$73.0M	8.4%	0.90	10.4%
Vancouver, BC	\$72.4M	8.3%	0.62	7.1%
Surrey, BC	\$45.1M	5.2%	0.34	3.9%
Richmond, BC	\$27.4M	3.1%	0.26	3.0%
Ottawa, ON	\$27.0M	3.1%	0.38	4.4%
Victoria, BC	\$22.0M	2.5%	0.18	2.1%
Saanich, BC	\$21.4M	2.5%	0.22	2.6%
Toronto, ON	\$20.2M	2.3%	0.30	3.5%
Burnaby, BC	\$19.3M	2.2%	0.16	1.9%
Abbotsford, BC	\$16.8M	1.9%	0.13	1.4%
National Total	\$871M		8.65	

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tion of Total)	
.4%	
1%	
9%	
0%	
4%	
1%	
6%	
5%	
9%	
4%	
Canada	





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Key Findings

- A handful of communities have disproportionately high risk: Montreal, Vancouver, Surrey, Richmond, Victoria, Ottawa, Toronto
- Eastern Canada has higher risk than appreciated by the public
- High relative risk in small communities in western Canada
- Pre-1970's buildings make up 77% of average annual fatalities
- Wood has highest annual financial loss, but concrete and URM have highest annual fatalities
- onately high risk: ictoria, Ottawa, Toronto ciated by the public estern Canada age annual fatalities













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