FP3:Prioritising Earthquake Retrofitting in Wellington CBD

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1. ISSUES & RESEARCH QUESTIONS

Main issues

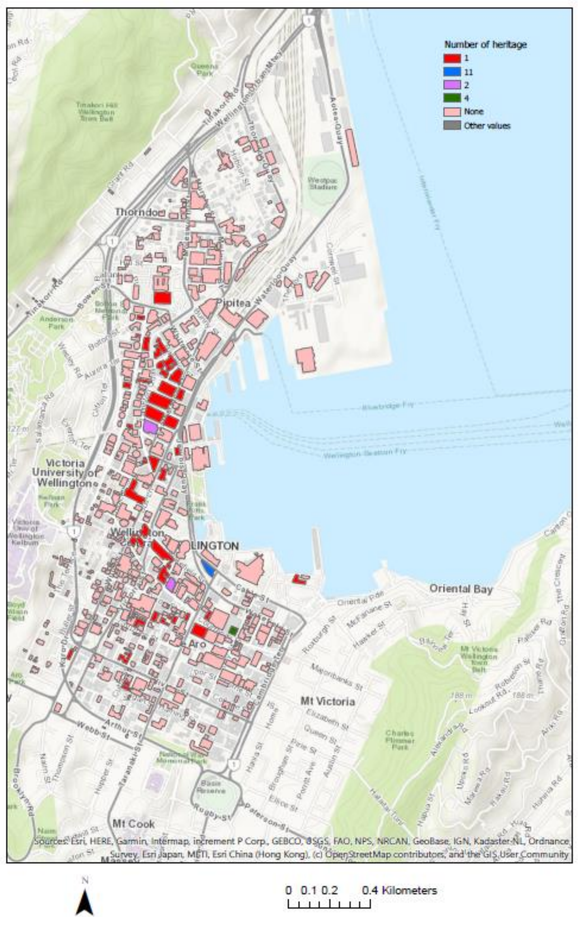
- The most recent earthquake strongly affecting Wellington was the Kaikoura Earthquake in 2016. It caused damage to a significant number of office buildings across Wellington. In the Christchurch earthquake in 2011, the collapse of one reinforced-concrete office building accounted for 60% of fatalities in the catastrophe. The Kaikoura event raised awareness of the need to strengthen buildings in Wellington.
- The current mandated strengthening is only based on the Earthquake Prone designation, based on the current New Building Standard (NBS) (EQP < 34% NBS). However, in the very damaging Kaikoura earthquake, most of the damage occurred in office buildings (5 stories and above) of reinforced concrete (RC) buildings. These of buildings were not and are not designated earthquake-prone (EQP).
- Furthermore, before the Kaikoura earthquake the research community and policy makers focused on older unreinforced masonry (URM) buildings and buildings built before 1976, because of their acknowledged seismic vulnerability. However, evidence from the recent events shows that some newer buildings (post-1980s) also have potential structural risk to human life.

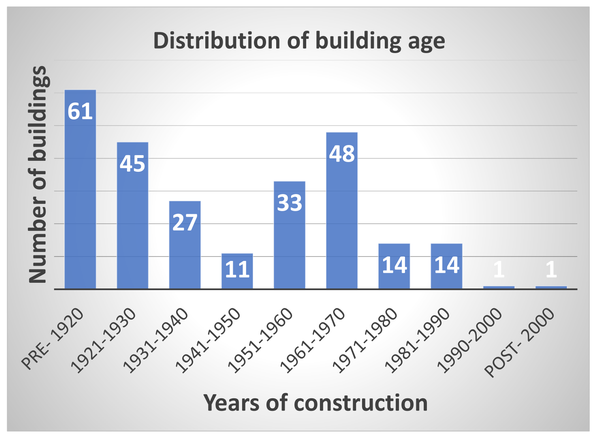
Research questions

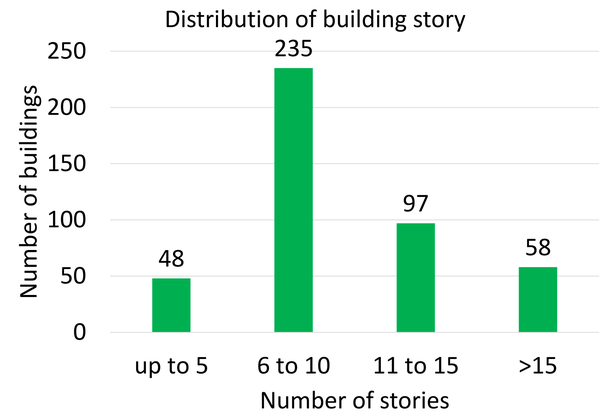
How should the seismic retrofitting of Wellington CBD buildings be prioritized?

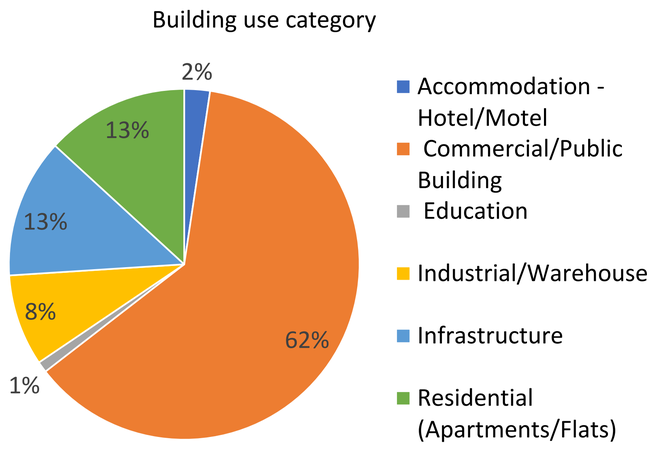
2. DATA

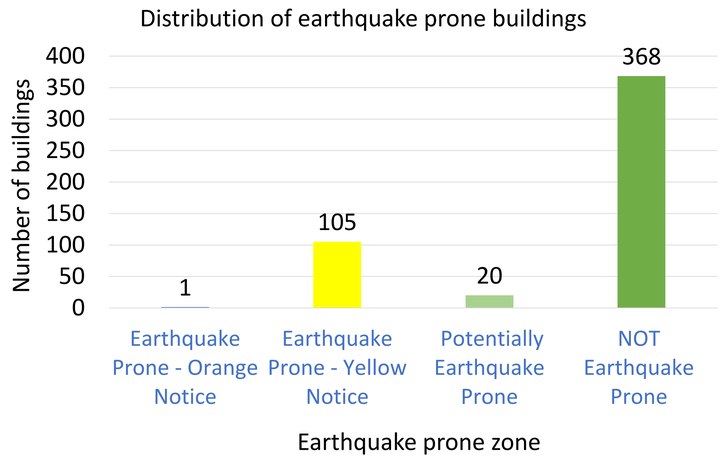
Wellington heritage buildings





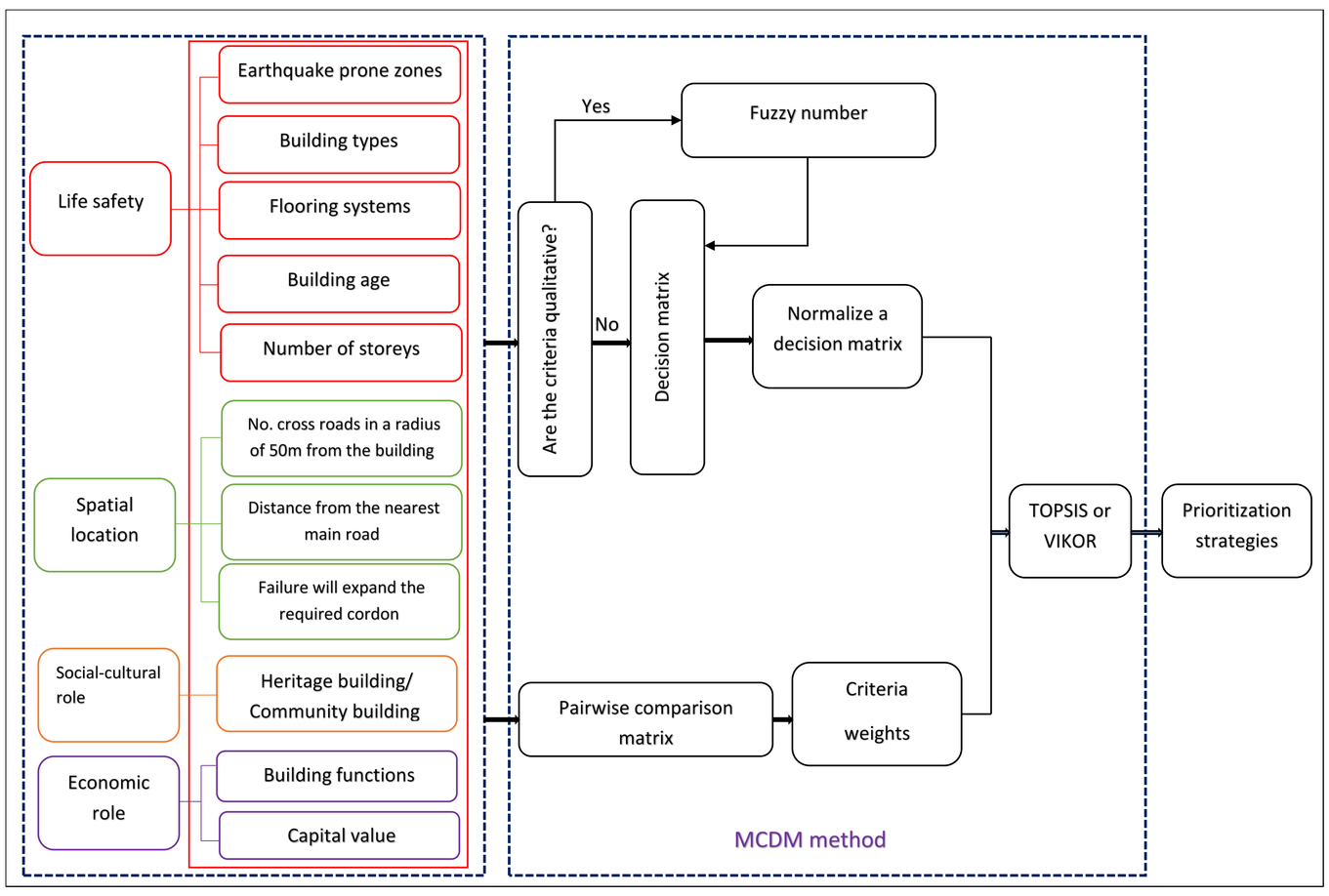






3.MULTI CRITERIA DECISION MAKING METHOD

Suggested procedures to define prioritization strategies



- We consider 4 buckets: Life safety, spatial location, social-cultural role, and economic role.
- For qualitative data: By using fuzzy set theory, the value of the attributes can be first decided as linguistic term, converted into corresponding fuzzy numbers and then converted to the crisp scores.
- TOPSIS method leads to the optimal solution on the basis of the distance from the ideal alternative and the distance from a negative-ideal alternative defined from the worst performances of the alternatives
- VIKOR method defines the optimal solution on the basis of the satisfaction of each criterion, defining different weight for all criteria and the individual response to the single criterion

Questionnaire survey to determine the weight of criteria

- We use the analytic hierarchy process (AHP) method proposed by Saaty (1980) to determine weight.
- A survey questionnaire is designed to explore the opinions of stakeholders
- The participants compare the relative importance of the criteria

Questionnaire Survey
Prioritising Earthquake Retrofitting in Wellington CBD

Participants' information:

Q1. What is your profession or occupation?

1. Researcher (engineer)
2. Researcher (other physical science)
3. Researcher (social science)
4. Practicing engineer
5. Government/policy
6. Other

Q2. How many years have you worked in your field?

1. 0-5
2. 5-15
3. Greater than 15

Q3-Q8

When deciding which building to prefer to retrofit, which criteria is more important? Using the scale from 1 to 9 **(where 1 is A is much more important than B, and 9 where B is much more important than A)**

A Option	Extremely	Very strongly	Strongly	Moderately	Equally	Moderately	Strongly	Very strongly	Extremely	B Option
Life safety	1	2	3	4	5	6	7	8	9	Spatial location
Life safety	1	2	3	4	5	6	7	8	9	Social-cultural role
Life safety	1	2	3	4	5	6	7	8	9	Economic role
Spatial location	1	2	3	4	5	6	7	8	9	Social-cultural role
Spatial location	1	2	3	4	5	6	7	8	9	Economic role
Social-cultural role	1	2	3	4	5	6	7	8	9	Economic role

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