

A STUDY OF SEISMIC STRENGTHENING COSTS OF EQPBs:

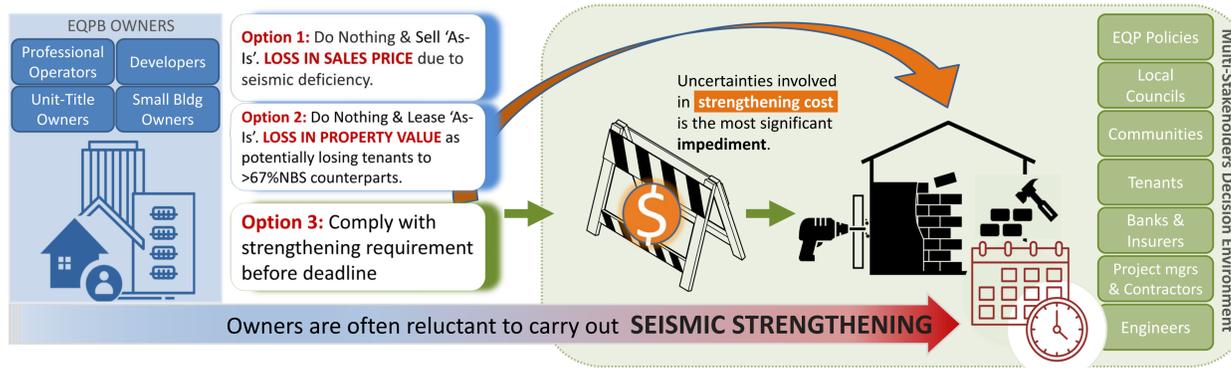
REDUCING UNCERTAINTIES AND IMPEDIMENTS FOR FASTER SEISMIC STRENGTHENING COMPLIANCE

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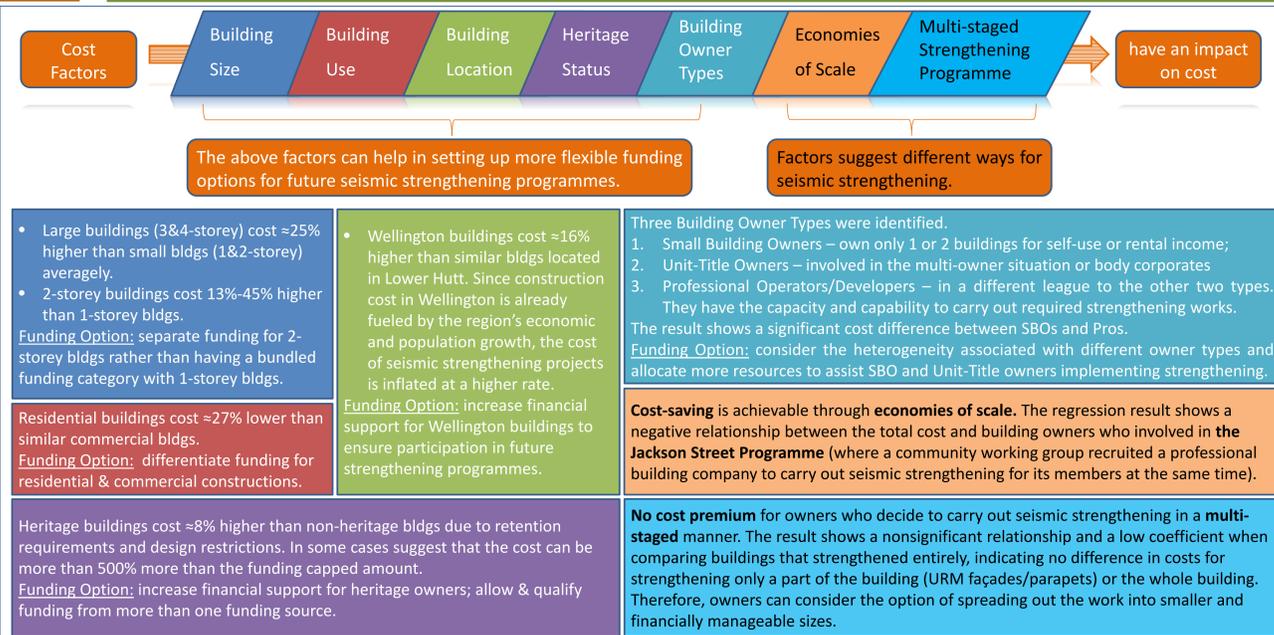
Rationale

Earthquake-prone buildings (EQPBs) are a major concern for public safety and community resilience. The Building Act requires EQPBs owners to remediate/remove seismically vulnerable building structures by specific deadlines, however, owners are often reluctant to carry out remedial works¹. The decision-making of seismic strengthening implementation begins with owners' choice among three options (of sell, lease, or comply). While the decision-making process is influenced or impeded by multiple stakeholders, **uncertainties involved in cost** is the most significant impediment for seismic strengthening implementation². Owners generally perceive the cost too excessive to initiate any remedial works, yet the lack of accuracy in cost estimation due to hidden or additional works exacerbates the uncertainties involved in seismic strengthening.



The recent URM [Unreinforced Masonry] Programme provided actual construction invoices and the funding administration data, which enabled the investigation of seismic strengthening cost. The study aims at reducing the uncertainties involved and providing useful insights to motivate owners in going forward with complying strengthening requirements. The cost pattern suggests that cost varies depending on the typology of building classifications (i.e. physical characteristics of buildings and building use). A regression model is also developed to identify cost factors significant in seismic strengthening, which serves to formulating more flexible funding options for future government-led programmes. In additions, **three case studies** of the most common scenarios are discussed contributing to the understanding of challenges & opportunities ahead for EQPB owners.

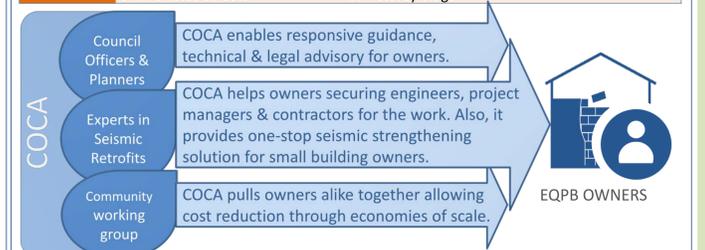
Seismic Strengthening Cost Factors



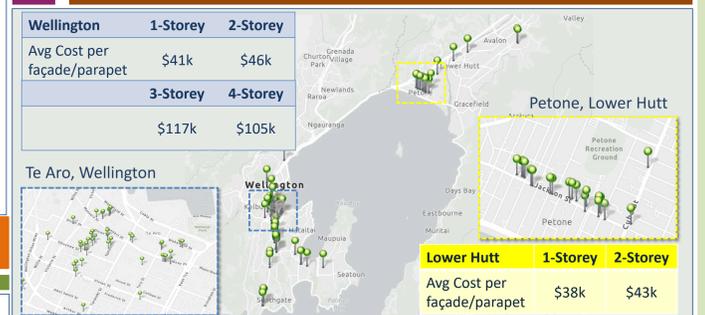
The URM Programme

After the 2016 Kaikoura Earthquake, the URM Programme was established in response to a heightened risk of further earthquakes occurring in four territorial authorities (Wellington City, Lower Hutt City, Marlborough District, and Hurunui District). The affected councils issued 189 s124 notices, requiring seismic strengthening of dangerous URM parapets and facades on major thoroughfares within a strict 18-month deadline. With a concerted effort by building owners, the URM Programme successfully lifted 188 out of 189 notices, eliminated falling hazards of URM building elements³. Government funding and local councils' **Cross-Organisational Collaborative Approach (COCA)** played the crucial roles to the success via providing effective financial and technical supports that owners needed under the URM programme.

	Description	Funding Cap (excluding GST)
Category A	No remedial work required	Max. \$1,500 for engineering assessments
Category B	1 or 2 storey bldgs	Max. \$25k for a façade/parapet per listed street
Category C	3 or 4 storey bldgs	Max. \$65k for a façade/parapet per listed street
Category D	Bldgs situated at the intersection of two listed streets	Max. \$50k for 1 or 2 storey bldgs; Max. \$130k for 3 or 4 storey bldgs.



Cost Indications



Case Studies – Challenges & Opportunities

CS#1 Single Owner, 2-Storey bldgs

CS#1 bldgs are generally 2-storey commercial or mixed-use properties. They are popular among purchasers who look for home-and-income properties and developers who renovate/convert the upper-level office space.

Challenges:

- It is hard to secure necessary engineers & contractors for seismic strengthening since the project is relatively small and risky.
- Owners are lacking of construction & project mgmt experience to navigate the work.

Opportunities:

- Converting the vacant space upstairs into residential flat for added income.
- Undertaking seismic strengthening through economies of scale to save on cost. E.g. **The Jackson Street Programme** - a community working group engaged a professional building company to carry out strengthening for its members at the same time.

Example: This is a mixed-use building originally built in the 1920s. The upper-level space was converted into a residential apt, while the ground level remained as a retail space. The property has an estimated rental of \$60k + GST in Sep-17.

CS#2 Multi-Owner Residential bldgs

CS#2 bldgs are multi-storey residential apartments. Unit-title ownership is associated with this scenario and any seismic strengthening decisions have to be made through Body Corporates.

Challenges:

- The majority of owners tend to be the retired population, and the unit is their primary residence.
- Each owner has different financial status; if one owner decided not to strengthen or to sell 'as-is', then the project will be delayed.
- Insurance premium has become unsustainable with natural disaster covers.

Opportunities:

- Government offer a low-interest loan scheme to help with the strengthening cost.
- Stable rental returns and long-term growth projection for apartments.

Example: The Bond Store is a former industrial bldg. It was modified into residential apts in the late 90s. During the URM Programme, their initial contractor walked away the day before the work started. Although another contractor was secured promptly, the work itself was challenging. It was carried out around occupied units. Structural steels had to be lifted through narrow window openings, and furniture has to be moved around to allow installation.

CS#3 Three+ Storey Commercial bldgs

CS#3 bldgs are large commercial bldgs. The building complex consists of multiple tenants which typically has retail shops on the ground level and office spaces on the upper levels. Some bldgs have a basement area as storage or car parking spaces.

Challenges:

- Increased complexity in building structure which requires sophisticated engineering solutions for future seismic strengthening stages.
- Needs to accommodate various tenants' requirement and to work around their working hours for minimum business disruption.

Opportunities:

- Owners are professional operators and property developers who have the means and expertise to strengthen the building to maximise returns.
- Strengthen the bldg to >67%NBS eliminates uncertainties and attract more tenants.

Example: This bldg is currently undertaking a redevelopment. Given a large-scaled strengthening work is required, the developer has chosen only to strengthen the heritage façade rather than carry out seismic strengthening for the 100-year-old building structure. The redevelopment includes the rebuilding of an entirely new structure to 130%NBS and shop fit-out for new tenants.

References
1. Egbelakin, T. K., Wilkinson, S., Potangaroa, R., & Ingham, J. (2011). Challenges to successful seismic retrofit implementation: a socio-behavioural perspective. *Building Research & Information*, 39(3), 286-300.
2. Egbelakin, T. K., Wilkinson, S., & Ingham, J. (2014a). Economic impediments to successful seismic retrofitting decisions. *Structural Survey*, 32(5), 449-466. <https://doi.org/10.1108/SS-01-2014-0002>
3. Falcon Consulting. (2019). *Unreinforced Masonry Buildings Programme: Debrief Report to Wellington City Council*. <https://wellington.govt.nz/-/media/services/rates-and-property/earthquake-prone-buildings/files/umr-debrief-final-report.pdf?la=en>