NEMA Resilience Fund

Technical Note

Evaluating Existing Buildings as Emergency Operations Centres and Emergency Co-ordination Centres:

Understanding the Likely Operational Status of the Facility

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Document Information

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Contents

1. Introduction

1.1 Background

The criteria for new buildings to meet in relation to seismic performance when used as an Emergency Operations or Co-ordination Centre are not as clearly defined as many people think. Importance Level 4 requirements apply to *structures with special post-disaster functions,* but are defined in relatively broad terms only. They have a twin focus on life safety in severe natural hazard events (ie. those with a 1 in 2,500 year return period) and being operational following 500 year return period events.

The basis for enabling operational use is however only captured in the high-level design objective of minimising damage to structural and non-structural components. Criteria for *Functionality* (or *Usability*) as it applies to operational facilities is not defined in either building regulations or current technical guidance.

Furthermore, relatively few EOCs and ECCs currently operate out of purpose-designed facilities that meet Importance Level 4 requirements. In many cases, key operational facilities are located in existing buildings adapted from their original or previous use. While in these situations a seismic assessment will usually have been undertaken, the resulting seismic rating only addresses life safety matters, and so relatively little is known about the likely *usability* of the building following a major earthquake (or other hazard event).

The wider issue is that there is currently no technical guidance for the other operational requirements beyond the structurally-focused Importance Level 4 provisions for either the design of new or evaluation of existing operational facilities.

1.2 The EMBOP/BOPRC GECC Project

In the post-Covid 19 financial environment that developed in 2020, Bay of Plenty Regional Council were required to re-evaluate previous plans for the construction of a new CDEM Group Emergency Co-ordination Centre in Tauranga.

This involved the comprehensive evaluation of the Council's recently upgraded four storey 1980s office building premises for its suitability across the full range of hazard events and return periods, having regard to aspects such as location for access as well as the likely physical impacts. This resilience review confirmed the suitability for GECC purposes of the for all hazard and threat scenarios except a major earthquake. The review then undertook a closer examination of the likely response of the building compared to that of an equivalent new IL4 building, in order to understand the circumstances where the building may not be usable following a major earthquake.

1.3 Linkages with the National Disaster Resilience Strategy

The second principal theme of the National Disaster Resilience Strategy is *Effective response to and recovery from Emergencies*.

While the associated objectives don't specifically refer to operational facilities such as EOCs and ECCs, having a high level of confidence in the ability of these designated facilities to fulfil their function following a major emergency is reflected in words such as *capacity* and *capability*.

Understanding the relevant dimensions of building performance associated with *continued functionality*, and being able to evaluate existing buildings against these is therefore an essential first step of meeting the goal of the Strategy of *being ready to respond to and recover from emergencies*.

1.4 Scope of This Report

This Technical Note is provided to convey an example of current practice in the evaluation of existing buildings housing EOCs and ECCs for use following earthquakes, and to introduce key concepts for wider consideration. The associated purpose is to promote further discussion around better defining operational expectations and establishing functionality criteria for both new and existing buildings that may require going beyond basic building regulatory requirements, including the central concept of *post-earthquake usability*. An outline of current thinking about key measures required to ensure that specific and robust post-earthquake arrangements are in place is also provided.

Section 2 provides a brief discussion of the general operational requirements associated with an EOC or ECC. An overview of building importance level requirements for structures with special post-disaster functions is given in Section 3, along with the differences in their application to new and existing buildings.

Section 4 summarises the project that the Bay of Plenty Regional Council (BOPRC) and Emergency Management Bay of Plenty (EMBOP) undertook during 2020 to evaluate the suitability of an existing building for use as the region's GECC across the range of natural hazard events.

Section 5 outlines the issues involved in assessing and conveying the likely damage and operational impacts to an existing building from a major earthquake, and Section 6 summarises current good practice regarding the arrangements necessary to ensure rapid evaluation of actual damage following a major earthquake.

As part of this project, a workshop was held with a selection of people from the sector with recent experience in the design and construction of new IL4 buildings, and the key discussion points and outcomes of these workshops are summarised in Section 7.

An overall summary of the issues is provided in Section 8, along with the key overall recommendations.

It is considered that many of the issues encountered and the framework developed to work through them is relevant to all agencies with operational response requirements, including sectors such as Lifeline Utilities in relation to control rooms.

2. General Operational Requirements

The first and most fundamental requirement for an operational response facility is having dependable access to the building, and minimal risk from and geological features such as potential instability and other hazards such as flooding and tsunami. The location should also take into account the risk posed by adjacent and nearby buildings, including those on primary routes to the building. Reasonable proximity to council buildings and the facilities of other response agencies are also relevant considerations.

These considerations should be reflected in site selection, as they cannot practically be addressed through building design. For existing buildings, they should be also be evaluated to establish the level of risk associated with the site, ahead of any decision to upgrade the building.

Other considerations to meet the objectives of both *immediate functionality* and *sustaining prolonged operations* include:

- Continued and dependable provision of critical services such as emergency power serving the whole facility, potable water and wastewater.
- Robust primary and alternative communications systems to enable both voice comms and data transmission
- Being accessible for authorised representatives from agencies other than CDEM agencies (but secure from access by members of the public)
- Fire suppression measures that can continue to function
- Ventilation systems that support 24/7 occupancy of people beyond normal office occupancy levels for a potentially extended period of time

The location and arrangements for emergency power must include fuel storage of sufficient capacity, along with safe access for re-fuelling. This should include realistic considerations of post-disaster re-fuelling prospects (eg. access to the site, and supply from the fuel storage base).

These requirements form a critical part of the design brief for both upgraded and new emergency operations facilities to enable post-disaster usability, and extend beyond the structurally-focused IL4 provisions covered in the next section. They are not outlined in any form of national guidance, and the notes above represent only a high-level summary.

3. Overview of Importance Level 4 Requirements

3.1 Background to Importance Levels

Building resistance for earthquake, wind and snow hazards has been set since the 1970s by a risk factor that reflects building importance classification. The higher importance levels are used in cases where structural failure would lead to an unusually high level of life, economic or other loss; or to meet post-disaster operational requirements.

Importance Level requirements are defined in the New Zealand loadings standard AS/NZ1170 Part 0 for structural purposes (for wind, snow and earthquake), and in Section A3 of the Building Code for fire purposes. They are predominantly used for the structural design of new buildings and in the seismic assessment of existing buildings, and are categorisations that the engineer selects. This can be from either by knowledge of the use of the facility, or guided by the owner. Any owner can always go beyond the minimum provisions of the Building Code and standards and self-select a higher category. They are not a formal designation as such.

The Importance Level classifications reflect the consequence of failure of the building, as shown in Table 3.1 from AS/NZS1170 Part 0 reproduced below.

Consequences of Failure	Description	Importance Level	Comment
Low	**Low** consequence for loss of human life, *or* **small** or **moderate** economic, social or environmental consequences	1	Minor structures (failure not likely to endanger human life)
Ordinary	**Medium** consequence for loss of human life, *or* **considerable** economic, social or environmental consequences	2	Normal structures and structures not falling into other levels
High	**High** consequence for loss of human life, *or* **very great** economic, social or environmental consequences	3	Major structures (affecting crowds)
		4	Post-disaster structures (post-disaster functions or dangerous activities)
Exceptional	Circumstances where reliability must be set on a case by case basis	5	Exceptional structures

Importance Level 4 provisions apply to *structures with special post-disaster facilities,* which typically includes Police, Fire and Ambulance stations, key hospital facilities, lifeline utility control rooms and civil defence emergency operations centres.

Another point to note is that the building overall assumes the highest applicable Importance Level within the building – that is, the IL corresponds to the most critical function applying in the building. This is particularly important for large buildings, and also highlights the need to understand the extent to which sections of buildings may be structurally interconnected.

Buildings that are essentially offices but include an EOC (in the Council chambers, for example) are therefore typically required to be classified as IL4. The only exception to this is where the section of the building that is required to be IL4 can be shown to not be physically affected by the behaviour of the other sections of the building under either design loadings.

As noted above, Importance Levels are required to be applied to the design of new buildings and the seismic assessment of existing buildings. There are however no legal or regulatory requirements for existing buildings housing operational facilities to fully meet IL4 requirements, as discussed further in Section 2.4.

3.2 IL4 Building Design Requirements

The provisions of AS/NZS1170 Part 0 relating to IL4 buildings address two aspects:

- **Life Safety requirements** – the primary structure and parts of the structure representing a hazard to human life inside and outside the building are designed to withstand a 1 in 2,500 year event without endangering the occupants (Ultimate Limit State, or ULS); and
- **Operational Continuity** – minimal damage to non-structural and structural elements, and hence the ability to establish or continue operations in a 1 in 500 year event (Serviceability Limit State 2, or SLS2)

The 2,500 year return period requirement for life safety corresponds to the primary structure having to be designed (or assessed) to seismic loadings 1.8 times that of an ordinary office building. The factor for wind loading is much less, typically being between 1.1 and 1.2.

Operational Continuity requirements are not currently clearly defined. Adding to this challenge is that the extent of damage that can reasonably be accommodated before the building becomes unusable depends on the operational function or activity that gives rise to the IL4 categorisation. Whereas for a hospital operating theatre any damage to specialist medical equipment, service lines or overhead components can render the facility unusable, degrees of non-structural damage in an emergency operations centre may well not affect its operational use. There is a parallel consideration for lifeline utility control facilities, where the use of control technologies means that the networks can be operated remotely for a period of time.

It is important to appreciate that the SLS2 requirements reflect a broad and non-specific performance objective, rather than being specific criteria. They focus on enabling the immediate post-earthquake *functionality* of the building, and don't represent a no damage requirement.

Minimising damage to structural and non-structural elements typically involves a stiffer primary structural system in order to limit lateral movement. Attention also needs to be paid to the detailing of the junctions of non-structural elements such as lining systems, etc to accommodate the movement that will occur.

Another area of attention is the provision and specific design of seismic restraints of non-structural elements in accordance with NZS1170 Part 5, with a focus on:

- Heavy plant and equipment (including Lifts)
- Ceiling systems (suspended and fixed) and lighting and other overhead elements
- Partitions (especially around escape routes)
- Glazing elements (façade and internal)

The effective seismic restraint of heavy contents also needs to be addressed, with NZS4219 providing a key point of reference for general items.

3.4 Application of IL4 Requirements to Existing Buildings

There are no legal or regulatory requirements in the Building Act and Building Code for existing buildings used as facilities with special post-disaster functions to fully meet the requirements of an IL4 structure, either as a current use, or as a consequence of a change in location, unless a change of use applies.

The Engineering Assessment Guidelines[1] however recommend *that an IL4 building should either attain a 67%NBS (IL4) rating as a minimum and fully satisfy SLS2 requirements, or be re-designated*. This recommendation reflects the critical importance of most IL4 buildings to the community.

However, the current reality is that many buildings designated for use in operational response are currently not capable of meeting these requirements – especially the operational continuity (SLS2) requirements – and so re-categorisation in itself will not necessarily address the situation. A clearer understanding of the post-earthquake implications of a building not meeting the SLS2 requirements nevertheless needs to be conveyed, including suitable alternative facility arrangements being established in the Emergency Response Plan.

[1] MBIE, NZSEE, SESOC, NZGS & EQC *The Seismic Assessment of Existing Buildings: Technical Guidelines for Engineering Assessments. Part A* July 2017

There is also no specific provision in the CDEM Act that addresses operational facilities. The provisions in s59 of the CDEM Act however appear relevant:

> *Every department, Civil Defence Emergency Management Group, local authority, emergency service, and lifeline utility, and any other person required by this Act or any regulations made under this Act, or any civil defence emergency management plan, to undertake civil defence emergency management or to perform any functions or duties, must take all necessary steps to undertake civil defence emergency management or to perform those functions and duties*

The highlighted phrase infers the principle of continuous improvement, which suggests that continuing to operate over an extended period of time in a facility that is significantly short of current Building Code standards is contrary to the expectations of these agencies.

When an existing building is being assessed for structural purposes, the outcome of a seismic assessment is expressed as the *percentage of New Building Standard*, or %NBS. This rating however only addresses life safety considerations in a severe earthquake (2,500 year return period) and provides little insight about likely damage (and hence the likely usability) in a 500 year event.

Understanding the potential damage in a 500 year earthquake in order to qualitatively compare the likely performance (usability) against that of an equivalent new building is however the key issue in evaluating the suitability of an existing building. Engineers should be specifically briefed to address this issue.

The key requirement for an existing building when used as for a *special post-disaster function* is therefore to look beyond the %NBS rating and understand how usable it is likely to be following a major earthquake (500 year event). 'Usability' has several dimensions, with no degree of certainty. The starting point is that there are no absolute guarantees that even a newly designed and constructed IL4 building will be operational after a major natural hazard event, especially earthquake.

The lack of specific functionality criteria for new IL4 buildings as commented in in section 2.2 adds to the challenge in determine the likely usability of an EOC or ECC facility.

There are many additional factors to be considered for multi-storey buildings. These include the performance of stairs and precast concrete floor systems. The human perceptions of the safety of multi-storey buildings following significant earthquakes also leads to the general view that they are not well suited for use as operational facilities.

4. Evaluating Location Options for the Bay of Plenty CDEM Group Emergency Co-ordination Centre

4.1 Overview

BOPRC were proceeding in early 2020 with plans for a new GECC facility for EMBOP to be designed and constructed. However in the face of post-Covid 19 lockdown budget reviews and constraints, BOPRC were faced with having to review and adjust their expenditure priorities.

The question of whether the GECC could function effectively within BOPRC's main office building in Regional House was then required to be evaluated. A full upgrade of this five storey building had recently completed, including structural work to achieve 100%NBS for Importance Level 2 (general office) occupancy.

A risk and resilience review was then carried out to see whether this building was suitable to accommodate a GECC, and to compare this option with the previous plans for a new purpose built facility.

4.2 Legal and Regulatory Considerations

The legal requirements in relation to GECC accommodation are addressed in two pieces of legislation - the Building Act 2004, and the Civil Defence Emergency Management Act 2002.

As outlined in the previous chapter, if a new building is constructed to house the GECC, the building must be designed to fully meet the IL4 requirements in order to comply with the Building Act. If however the GECC is housed in an existing building, it is only required to meet a minimum of 34%NBS of an IL4 building. Regional House had been upgraded to 100%NBS at IL2, which equates to 55%NBS at IL4.

Both the Regional Council as a local authority and the CDEM Group have additional obligations under s59 of the Civil Defence Emergency Management Act, including that they '*must take all necessary steps to undertake civil defence emergency management or to perform those functions and duties'*. However as noted in the previous section, there are no specific obligations under the CDEM Act to provide a building of a certain status to fulfil the function of the GECC.

As part of taking all necessary steps under s59, BOPRC and EMBOP undertook to ascertain the level of operational risk if the GECC was to be located in the building housing general regional council activities.

4.3 Risk Resilience Review

A GECC risk and resilience modelling exercise was undertake in order to:

- Determine the scenarios and risks which the GECC premises and any alternative options may be subject to Bay of Plenty regional hazards.
- Develop a decision criteria matrix and weighting of criteria to establish the basis on which the GECC options could be measured to determine suitability.

The two options evaluated for the GECC were firstly, a purpose-designed and built new facility and secondly, occupancy of vacant space within Regional House.

Hazard information was drawn from existing information held by the BOPRC Hazards Team, across the range of natural hazards that could affect the operation of the building.

While the 1 in 2,500 return period requirement drives the strength requirements for life safety as noted previously, it is the 1 in 500 year return period criteria that addresses the continued functionality criteria represented by SLS2 requirement for new IL4 buildings. Accordingly, the focus of the earthquake scenario used in the risk evaluation process was on 500 year ground shaking.

During the risk evaluation process, categories of ***Usable***, ***Usable Within 24 Hours***, and ***Unusable*** were defined as the risk outcome for each building. These categories and the evaluation process are explained further in the following section.

The risk resilience modelling showed that both GECC facility options of a new purpose-built GECC, or the GECC facility being accommodated within Regional House have the required operational risk resilience, with the exception of the Regional House option in a 1 in 500 year seismic event. In a major earthquake such as this, Regional House would be less resilient than a new purpose built GECC facility would be.

Mitigation measures to minimise the impact of the risk of being unable to operate the GECC from within the building were identified. These included having a priority response agreement with local engineers to inspect the building quickly following a major earthquake, and having seismic instrumentation installed to assist with this rapid assessment (refer Section 5.3).

The review concluded that even with the additional mitigations, there would still be a residual risk that Regional House would be unusable for an extended period of time following a major seismic event. The review also noted that there was also a possibility that a purpose-designed IL4 building may sustain damage (direct or indirect) that could render it unavailable.

In December 2020, BOPRC and the Bay of Plenty CDEM Group agreed to proceed to fit out one of the upper levels in Regional House for the CDEM Group ECC.

5. Assessing the Likely Damage to an Existing Building from a Major Earthquake and the Operational Impacts

5.1 Overview

The actual performance of an individual building, including the likely levels of damage, cannot be accurately predicted for the range of potential earthquakes. Each earthquake has different shaking characteristics, and the different as-constructed details of the building (particularly for the non-structural elements) will also influence the actual damage.

It is important that the seismic assessment reflect the information and requirements of the current national seismic assessment guidance. This was released in July 2017 to accompany the changes to the earthquake prone provisions of the Building Act, and further updated for concrete buildings in November 2018. Earlier assessments, many of which were more basic assessments, are unlikely to have addressed aspects such as heavy parts and components, which can significantly lower earlier ratings.

As noted earlier, the %NBS rating does not provide any real indication of expected damage, as it only addresses life safety considerations. The lower the rating however the greater the likelihood of damage to structural and non-structural elements.

The evaluation of an existing building for operational purposes should therefore focus on identifying the *nature* of damage that could occur and the corresponding potential for either building being unusable in the short or long-term. From this, an indication of the likelihood of the building not being occupiable following a major earthquake can be established.

This typically involves going beyond the basic engineering assessment, which focuses on the structural elements rather than the non-structural elements.

5.2 Evaluation Process

A 500 year return period earthquake represents the design level shaking to meet life safety objectives for office buildings. This is referred to subsequently as a *major* earthquake.

As noted earlier, a new Emergency Operations Centre is designed to more stringent Importance Level 4 requirements, which addresses the two objectives outlined in section 2, namely:

- Life safety in a 1 in 2,500 year event
- Enabling operational use following a 1 in 500 year event

In contrast, a range of different levels of damage can be expected under this level of shaking for buildings not specifically designed as IL4 structures.

The level of damage (and hence *usability* of a facility) in a 500 year earthquake is therefore considered to be the principal aspect to understand in evaluating existing buildings for use as an EOC or ECC.

5.3 Indication of Likely Damage

A high-level indication of the nature of damage anticipated to buildings of more than one storey with a range of strength levels and seismic ratings in a major (500 year return period) earthquake can be broadly characterised as follows:

Equivalent New Building designed to IL4

- No damage likely to structural elements
- Only minor damage likely to partitions and ceilings

Existing Building with mid-range %NBS rating

- Likely cracking to structural elements such as columns, beams and the corners of suspended floors in lower levels
- Stair flights will move with the floors, causing distress to the vinyl floor coverings and cracking to adjacent plasterboard
- Cracking to office space partition walls that are not adequately separated from the structure over
- Some ceiling tiles will have fallen, but these are typically lightweight in nature
- Rupture of some service pipes
- Lifts out of service

Existing Building with poor rating

- Points as noted above for buildings with mid-range %NBS ratings
- More extensive damage to vertical structural elements in the lower levels
- Damage to suspended precast concrete floors around the perimeter of the lower levels of the building, and in other locations (this relates to newer buildings)
- Extensive damage to non-structural elements throughout the building

One of the characteristics of some of these forms of structural damage is the time it can take for engineers to be confident that there has not been any compromise to life safety. Cracking to concrete elements such as floors can require extensive removal of floor coverings to enable mapping the nature and extent of the cracks, and hence their implications.

5.4 Expected Operational Impacts

Characterising the Impacts

In order to characterise the operational impacts of the anticipated earthquake impacts, three *usability states* can be used, as established for the BOPRC GECC resilience review:

- ***Usable*** - *minor damage but doesn't affect operations*
- ***Usable within 24 hours*** - *damage requires engineering assessment and/ or clean up or minor repairs*
- ***Unusable for more than 24 hours*** **-** *damage or other impacts require engineering assessment and repairs that will take a period of time*

Expected Operational Impacts

The potential operational impacts for different categories of buildings having regard to the anticipated damage indicated above can be summarised as follows:

A new IL4 building

- It is expected that a ***Usable*** state would result for a purpose designed operational facility
- It is however possible that the building receives some damage but is still ***Usable within 24 hours***
- The occurrence of damage or some other form of impact that renders the building ***Unusable for more than 24 hours*** cannot be ruled out

A pictorial representation of the possible distribution of those usability states for a new IL4 building is shown in Figure 1 below.

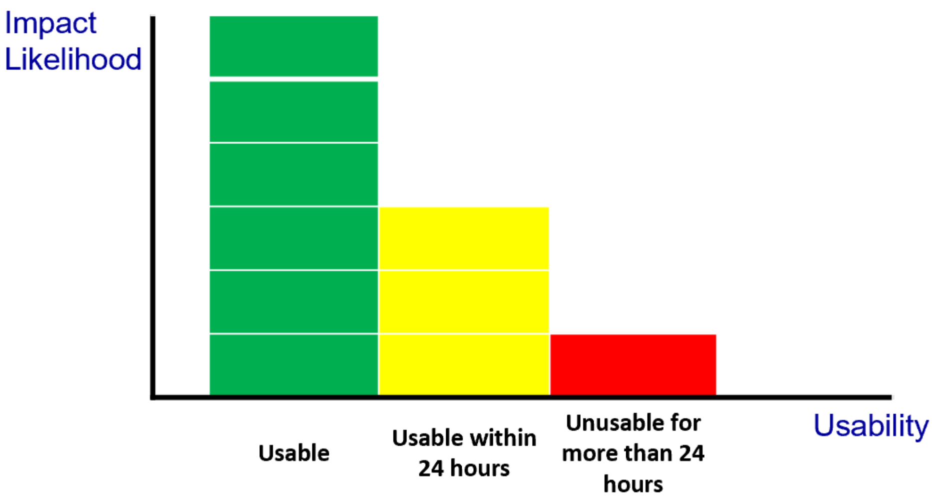

Figure 1: Possible distribution of usability states for a new IL4 building

An Existing Building

- While it is considered more likely that an ***Unusable for more than 24 hours*** state may well result, it is also possible that the building receives less damage and is ***Usable*** or ***Usable within 24 hours***
- The ***Usable within 24 hours*** state may result from either structural issues (as reflected in the %NBS rating) or issues from non-structural elements

A pictorial representation of the possible distribution of those usability states for an existing building is shown in Figure 2:

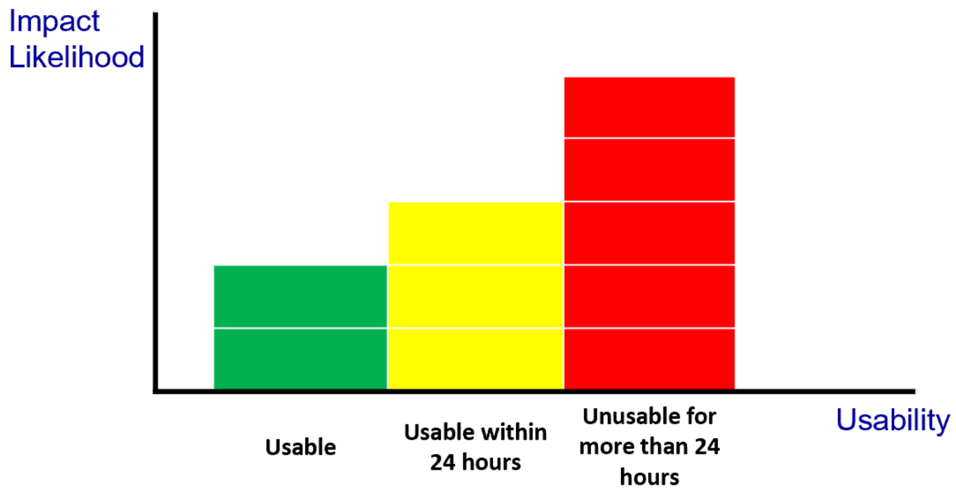

Figure 2: Possible distribution of usability states for an existing building

For either new or existing IL4 buildings, it is important to have processes and arrangements in place to develop a clear and early view on what the actual levels of damage mean. These aspects are expanded upon in the following section.

These measures may enable some situations that are initially perceived as being ***Unusable for more than 24 hours*** to become ***Usable within 24 hours***, as indicated in Figure 3 following.

There may be other forms of mitigation (for example, local strengthening of identified structural or non-structural vulnerabilities) that may increase the likelihood of 'unusable' that can be cost-effectively implemented in advance of full strengthening or relocation.

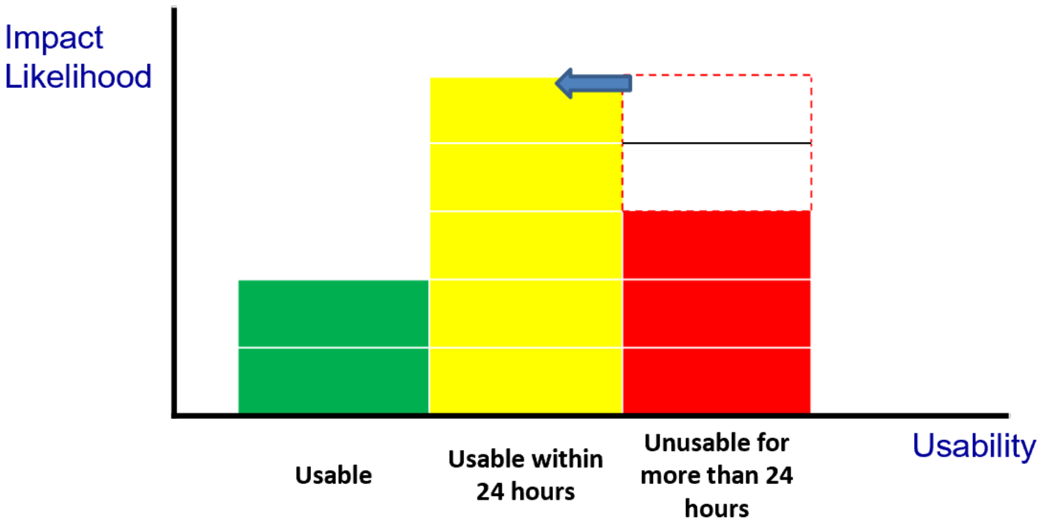

Figure 3: Potential impact of mitigation measures for an existing building

An alternative way of representing this is shown in Figure 4 following, where building *usability* is plotted against *resilience*.

This figure also reflects the uncertainty associated with assessment and design, which is important to represent when 500 year categorisations are a composite of several components. This representation conveys that even a new fully complying IL4 structure might not be able to be used for critical functions immediately following 500-year earthquake shaking for various unforeseen reasons. Conversely, even a building assessed as being highly vulnerable may receive only minor damage in a significant earthquake, and would therefore be usable.

This figure also reflects that seismic assessments of existing buildings endeavour to portray the *probable* or *expected* outcome in an earthquake, and they should represent neither an upper or lower bound scenario. This is important to bear in mind with respect to non-structural components.

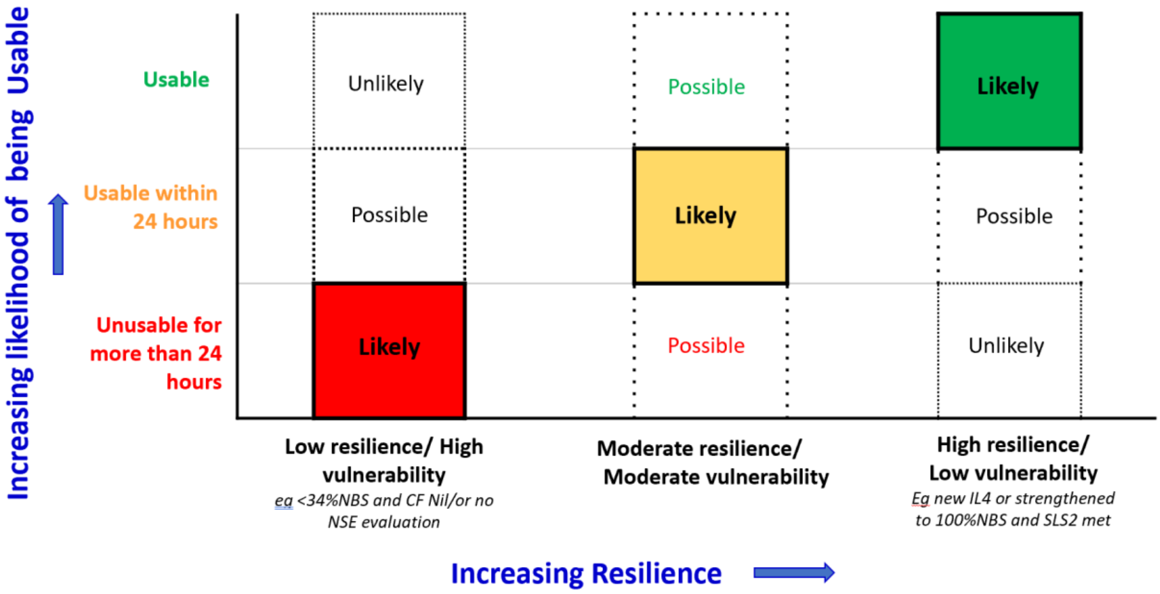

Figure 4: The Continuum of Vulnerability to Resilience *(focusing on a 500 year earthquake)*

6. Rapidly Evaluating Actual Damage Following a Major Earthquake

6.1 Overview

It is essential that any facility that is intended to be operational following a significant earthquake or other natural hazard should have specific arrangements in place for structural engineers to evaluate any damage.

The objective of this evaluation is to hopefully be able to confirm that if any damage is observed, it is minor in nature and not of structural significance, and that the building may be able to be occupied. The focus is on the function for which it is designated (in this case the EOC facility), and not necessarily the resumption of full normal occupancy and function.

In addition to having a specific agreement in place with engineers, consideration can be given to augmenting access to this capability with seismic instrumentation of the building. Both of these aspects are expanded upon below, and apply equally to both new buildings designed to fully meet IL4 requirements and existing buildings of any age and seismic rating.

6.2 Priority Response Agreements with Engineers

The optimum form of agreement with an engineering practice is referred to as a *Priority Response Agreement*. This agreement defines the expectations and arrangements for those who own and operate operational facilities (hence the reference to Priority), and the engineers who will be carrying out the post-earthquake assessment.

While the key elements of a Priority Response Agreement were developed in 2005 by the author for the New Zealand Society for Earthquake Engineering (refer to Appendix A), each agreement needs to be customised to meet the agency's requirements, and there is no template as such.

Earlier versions of Priority Response Agreements were established between national engineering consultancies and national lifeline utilities prior to the Canterbury Earthquakes. While these have taken different forms following the Canterbury and Kaikoura earthquakes, it is observed that very few CDEM Groups (or City or District Councils) have agreements in place with engineers for post-earthquake assessments of EOCs or ECCs.

The key philosophies that should underpin a Priority Response Agreement are:

- A clear commitment on the part of the consultant to respond as quickly as they are able to the facility, and ahead of other client commitments
- Acknowledgement by the operational agency or building owner that it is a 'best endeavours' agreement, but that if backed up with more than one listed engineer who is reasonably confident of being able to attend the site following a major event;

- The engineers are familiar with the building (either as designers or having undertaken a seismic assessment of the building or reviewed a recent assessment);
- The engineers have prepared a specific post-earthquake assessment plan – essentially a method statement for the process they will follow, covering how they will respond, how they will physically evaluate the building (including where they may wish to expose structural elements), and all relevant contact details

It is preferable that the agreement is between the owner of the building and the consulting engineering practice, with the operators of the facility (if a different agency) being active participants in the formulation of the assessment plan.

For an existing building, the process of familiarising themselves with the building will involve reviewing all previous design documentation and seismic assessments. The engineers may wish to undertake a partial or full seismic assessment for themselves if they have not already done so.

Many Territorial Authorities and Lifeline Utilities have well-established relationships with consulting engineering practices for the supply of a range of professional engineering services. Some of these agreements include provision for post-disaster response, but where this aspect is included, it is typically only at the practice level rather than with individual engineers, and with specific expectations and arrangements only rarely addressed.

6.3 Seismic Instrumentation

The objective of having seismic instrumentation installed in the building is to enable immediate information to support the engineer in their inspection and decision-making. This reduces the time taken by engineers to evaluate the response of the structure to significant earthquake shaking, hence hastening re-occupancy decisions.

In the first instance the responding engineer is looking for and reacting to signs of damage to both structural and non-structural elements throughout the building. As observed earlier, decisions to re-occupy can be most challenging in situations where the visible damage to primary structure is minor (with or without appreciable non-structural damage). Having appropriate seismic information installed informs the engineer on aspects like the proportion of design loading that the building has actually experienced, and in some cases the amount of structural movement that has occurred. This information can support the damage observations, and give the engineer confidence in making re-occupancy recommendations – or information to support a decision not to re-occupy the building.

Where the building is instrumented, the engineer must understand the nature of the output from the instrumentation, and be able to utilises the information. This forms part of the required preparatory work referred to in the previous sub-section.

Certain forms of seismic instrumentation are linked with an App that provides high-level summary information about the level of shaking that the building has experienced. In addition to assisting engineers to decide whether or not to respond to minor to moderate earthquakes, Facilities Managers and others within the host organisation can directly access this information.

7. Workshop Review Discussion and Outcomes

7.1 Workshop Framework and Participants

As part of the development of this Technical Note, a workshop was held with representatives of CDEM agencies that were either involved in recent IL4 EOC or ECC projects or with a current interest in this area to provide feedback on and confirm key elements of an earlier draft document.

This review workshop was hosted by Emergency Management Bay of Plenty as an online meeting on 26 November 2021, and involved nine representatives from the following agencies:

- EMBOP
- NEMA
- Auckland Council
- Taranaki CDEM Group
- Hawke's Bay CDEM Group
- Manawatu District Council

7.2 Workshop Outcomes

The workshop participants were supportive of the report content, findings and recommendations, and considered the information and commentary provided to be of value to the Emergency Management sector and other sectors with post-disaster operational responsibilities.

The recommendation for national technical guidance for the design and upgrading of EOCs and ECCs was strongly endorsed. This guidance should address other hazards in addition to earthquake.

Other key points highlighted in the workshop discussion included the following:

- The national guidance should include direction on the other elements necessary for EOCs beyond the structural and fire requirements associated with IL4 – eg. supporting infrastructure, ICT etc.
- The guidance should acknowledge the different community profiles and requirements between metropolitan, provincial and district centres. The need to also balance building availability and affordability at TA level was highlighted.
- Greater emphasis on the risks associated with the site from the perspective of dependability of access was encouraged – this was subsequently addressed by

separating this information into a new section 2 and providing additional commentary.

- It was noted that the requirements for the provision of EOCs and ECCs are not stated explicitly, and only referred to as expectations. Clearer statements of the basic requirements to be met would also assist the justification for facility upgrades and/ or replacement.
- The requirement for all EOCs (including those in new and near-new IL4 buildings) to have fully functioning alternate facilities is generally appreciated, but appropriate specific arrangements are often not set up in practice.
- The need for existing IL4 buildings to achieve higher performance than just meeting life safety objectives in extremely rare earthquakes is not generally appreciated. For example, achieving 100%NBS rating in a strengthened building doesn't equate to a new IL4 building, as it typically doesn't address the functional requirement for the building to be usable following a major earthquake.
- It was suggested that a stocktake of the status of current ECC and EOC facilities be undertaken by each CDEM group, and collated into a national summary report by NEMA. This will provide a clearer understanding of the current situation regionally and nationally, and may identify areas that the proposed national technical guidance should cover.
- It was noted that Priority Response Agreements with engineers need to be developed with due regard to regional engineering capacity and capability. This is thought to be best co-ordinated at CDEM group level, taking into account the similar needs of emergency services and key infrastructure providers.

8. Summary and Recommendations

8.1 Key Issues

The key issues in evaluating an existing building for use as an Importance Level 4 Emergency Operations or Co-ordination Centre can be summarised as follows:

a) There is no requirement for existing buildings housing operational facilities to fully meet Importance Level 4 requirements, as they only apply to new building design. Importance Levels are a risk consequence categorisation that is used in design and assessment; they are not a status or designation.

b) It is important that seismic assessments reflect the information and requirements of the current national seismic assessment guidance (July 2017, with November 2018 amendments for concrete buildings). Earlier assessments, many of which were more basic assessments, are unlikely to have addressed aspects such as heavy parts and components, which can significantly lower earlier ratings.

c) %NBS ratings only address life safety matters in major earthquakes and provide little insight about likely damage, and hence the more critical aspect of *usability*. While engineers cannot readily determine the level of damage to an existing building for a given level of ground shaking, they can provide informed commentary around structural and non-structural elements that are more likely to sustain damage.

d) Similarly, having an existing building upgraded to 100%NBS (IL4) only addresses life safety matters, and does not in itself address damage limitation in 500 year earthquake shaking.

e) There are many components in buildings that can impact on usability following earthquakes. While new IL4 buildings have to be designed to withstand 500 year return period earthquake shaking with minimal damage in order to meet the *immediate occupancy* objective, there are no guarantees of usability, and all EOCs and ECCs require fully functional alternate facilities.

f) There are considerations and requirements beyond the structurally-focused IL4 provisions for life safety and usability in order to provide both immediate functionality and the ability to sustain prolonged operations. These extend beyond the provision of emergency power, potable water and wastewater, and are not 'codified' or defined anywhere.

g) Specific and robust arrangements need to be put in place with structural engineers to evaluate EOCs and ECCs for damage following earthquakes, in order to be able to quickly confirm that the facility can be occupied for response co-ordination activities.

8.2 Recommendations

The previous points highlight issues in general terms that agencies need to be aware of for EOC and ECC planning purposes. The following specific recommendations are made for further consideration:

1. Engineers being engaged to undertake seismic assessments of buildings that are being (or are intended to be) used as EOCs and ECCs should be provided with a specific briefing to consider elements that go well beyond %NBS ratings and could affect usability. This could be developed as a standard national briefing document.
2. National technical guidance should be prepared for the design of new and upgraded EOCs and ECCs. This guidance should cover wider planning and resilience aspects necessary to enable both immediate functionality and to sustain prolonged operations, including access requirements and key infrastructure backup measures.
3. Agencies operating EOCs and ECCs should have specific Priority Response Arrangements in place with local engineers who are familiar with the premises and are in a position to respond rapidly following significant earthquakes.
4. New and upgraded EOCs and ECCs should have seismic instrumentation provided to assist facilities managers in minor to moderate earthquakes as well as responding engineers following major earthquakes.

Appendix A

Key Considerations in Preparing Priority Response Agreements with Engineers

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New Zealand Society for Earthquake Engineering

Improving the Emergency Preparedness of New Zealand's Critical Facilities Agencies

Key Considerations in Preparing Priority Response Agreements

August 2005

1. Introduction

Appropriate planning is clearly required to ensure that organisations with essential post-disaster functions can get dependable access to engineers and other technical personnel "on the day". In virtually all cases in New Zealand today, technical personnel at both trade and professional levels will be external to these organisations.

The primary objective is for critical facilities agencies to have ***designated technical personnel with specific response functions allocated.***

The associated functional requirements are that designated technical personnel should:

- Be familiar with emergency response processes generally
- Know what they have to do in their designated role
- Be familiar with the particular facilities (where appropriate)
- Be rapidly available with a high level of dependability

The primary mechanism for critical facilities agencies to meet these objectives is considered to be a ***Priority Response Agreement.***

2. Priority Response Agreements: Overview

Priority Response Agreements are prior written agreements between critical facilities agencies and (for example) consulting engineers to carry out immediate post-event safety inspections.

There are two principal objectives of such agreements, namely:

- Ensuring the availability of designated engineers and/ or technical personnel who are familiar with those facilities; *and*
- Minimising their response time by defining in advance the specific actions they are to undertake.

There is a range of issues relating to priority response agreements that need to be considered. The level of robustness of an agreement (or urgency of response) depends on the level of commitment made by both the agency and the consulting engineer.

These issues and the options in terms of the level of commitment and the resulting robustness of the arrangements are summarised in the table below. The level of robustness of an agreement (or urgency of response) depends on the level of commitment made by both the agency and the consulting engineer (with reference to the middle two columns). This will also influence the degree of formality of the agreement.

Aspects to be Addressed in a Priority Response Agreement

Aspect	Level of Commitment/ Robustness		Comments
	High	*Basic*	
1. Nature of required response	Automatic	Make contact first	Triggers must be defined for ‘automatic’
2. Numbers of engineers formally committed	>2	2	Measure of redundancy
3. Rendezvous arrangements	Designated location and target time frame	Not specified	
4. Initial Actions	Documented & practised	Documented	
5. Prior familiarisation	Seismic performance assessment undertaken	Prior walk-through	Need to know where construction drawings are located
6. Priority Actions			Agreed with management
Formality of Agreement	*Contract*	*Memo of Understanding*	

It is important to have the key elements documented in the form of at least a memorandum of understanding. The key elements and possible structure of a Priority Response Agreement are shown in the Annex.

Even for a Priority Response Agreement involving only a relatively “basic” level of commitment/ robustness, the expectations and duties associated with each of these aspects should be defined. In particular, liability issues need to be understood and documented, along with pre- and post-event remuneration. The process for an annual review of agreements including an update of contact details should also be specified.

For critical facilities such as hospitals, Priority Response Agreements also need to involve building services engineers.

3. Preparing a Priority Response Agreement: Key Issues

The focus of Priority Response Agreements are buildings and/ or facilities. The issues and considerations in preparing a Priority Response Agreement vary depending on the circumstances of the occupancy. The following table highlights the differing issues and key considerations facing engineers and critical facility operators in preparing Priority Response Agreements.

Priority Response Agreements: Understanding the Complexities

Situation Category	Example	Priority Response Agreement Issues for Engineers	Key Considerations
1. Single-storey building	Standalone Emergency Operations Centre (EOC); treatment plant or Control Centre	Relatively straightforward - dealing with one building and senior operators only	
2. Tenancy/ floor within multi-storey building	Corporate office EOC	Accessing other levels/ spaces and interacting with various tenancy representatives, with associated liability issues	• Prior interaction needed with owner and other tenants • Clarification of liability issues required • Know where plans, etc are located
3. Many buildings (eg. a Campus situation)	Hospital	Complex – a number of buildings to deal with, hence prioritisation issues	• Likely prioritisation necessary • Careful familiarisation required • Understanding of control/ assembly point, location of plans, etc • Several engineers briefed

Annex : Key Elements of A Priority Response Agreement

Part 1: General

- Purpose and Objectives
- Scope (building(s), etc)
- Best endeavours basis

Part 2: Preparation/ Familiarisation

- Familiarisation inspection of building undertaken
- Structural drawings accessible (specify location)

Part 3: Maintenance

- Annual meeting between engineer and facility or building manager
- Procedures for change in facility or building manager, or engineering personnel
- Procedures if changes to facility or building

Part 4: Response Expectations and Arrangements

- Activation triggers and notification (*automatic/ make contact first/ await call)*
- Number of engineers formally involved
- Default place of rendezvous

Part 5: Commercial Arrangements

- Name of organisations entering into agreement/ memorandum of understanding
- Permissions of other tenants/ occupiers obtained
- Liability issues (incl. situation where Agreement is with tenant rather than owner)

Appendix: Contact Details