

The Evaluation and Management of Buildings Following Earthquakes

***Overview Presentation to the
Canterbury Earthquakes Royal Commission
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Aspects Addressed

- **NZ's post-earthquake building evaluation arrangements**
 - Evolution
 - Comparison with international arrangements
 - State of development prior to the Canterbury Earthquakes
- **Implementation following the earthquakes**
 - Main shortcomings and issues identified
- **Subsequent events and developments**
- **Future arrangements: key considerations**

NZ Post-disaster Building Evaluation Arrangements

■ Elements

- ❑ Overall Damage Survey
- ❑ Rapid Assessment
- ❑ Detailed Evaluation

■ Basis

- ❑ Based on Californian approach developed by the Applied Technology Council (ATC)

Building Safety Evaluation

During a State of Emergency

Guidelines for Territorial Authorities



Prepared by the

**New Zealand Society for
Earthquake Engineering**

With support from



Department of
Building and Housing
Te Tari Kaupapa Whare



August 2009

Post-disaster Building Evaluation: GEN.BRU.0001.5 Assessment Levels

Level	Time Frame	By Whom
Overall Damage Survey	Within hours after the event	Emergency Services & Council staff
Rapid Assessment	During period of state of emergency	Volunteer engineers, building control officials, other building professionals
Detailed Engineering Evaluation	Immediate for critical structures; longer term for others	Contracted engineers, architects, loss adjusters

Rapid Assessment: Purpose

The Rapid Assessment process seeks to

(extract from NZSEE training material):

- ❑ Confirm where damage is concentrated to assist response and recovery decision making
- ❑ Indicate whether physical action to be taken to ***enable, restrict*** or ***prevent*** access
- ❑ Gather information for a database of damaged buildings that will assist the longer term Recovery actions

Rapid Assessment: Aims

(from Section 1.1 of NZSEE Guidelines)

Short-term aims for inspections include:

- **safe use of streets adjacent to damaged buildings**
- **safe occupation of buildings for:**
 - continued use, especially emergency facilities
 - minimisation of impact on commercial activity
 - minimisation of displacement of people
- **assessment of the need for temporary works such as shoring, temporary securing and making safe**
- **saving property from unnecessary demolition**
 - conserving heritage fabric
 - minimising economic impact for the owners and community

Rapid Assessment Levels

(extract from NZSEE training material)

Level 1 Rapid Assessment

- Quick exterior assessment of the type and extent of building structural damage

Level 2 Rapid Assessment

- To be performed on all critical facility buildings, and large, typically multi-storey buildings
- And on any other buildings where the Level 1 Rapid Assessment identifies the need for further and more specific inspection

NZ Development

- **1989** - NZ team involved in first US activation of ATC-20 procedures – San Francisco
- **1990** – Ministry of Civil Defence commissioned NZ procedures (Works Consultancy Services) based on ATC-20
- **1998** – NZSEE produced updated guidelines and distributed to all councils

NZ Development (2)

- **2004** – NZSEE commenced further update of guidelines
- **2007** – Gisborne earthquake 20 December; first NZ application of rapid assessments
- **2008** – Department of Building and Housing endorsed the update process, and established a National Reference Group to provide input into finalisation
- **August 2009** – National Guidelines for Territorial Authorities produced

NZ Development (3)

- **October 2009** – deployment of NZ volunteer team of engineers to assist agencies with rapid structural assessments following the Padang, Indonesia earthquake
- **July 2010** - Update of guidelines prepared (including draft Field Guides)
 - but not released pending review by National Reference Group

Comparison with International Arrangements

- **NZ Rapid Assessment (placarding) similar to US, Japan and Greece**
 - But NZ delivery mechanisms and numbers of trained personnel far less developed than US and Japan
- **European Union has similar categories but no placards**
- **Italy has different categories and no placards**
- **All are damage-based quick inspections**

Comparison with International Arrangements (2)

- NZ Rapid Assessment levels differ slightly from ATC-20

NZ	ATC-20
Rapid Level 1	Rapid
Rapid Level 2	Detailed

Californian Safety Assessment Program (SAP) GEN.BRU.0001.14

- Administered by the Californian Emergency Management Agency, supported by a steering committee of industry professionals
- Provides SAP Evaluators and SAP Coordinators to assist local government
- Database of more than 6,000 trained evaluators (engineers, architects, building officials) maintained, with photo ID
- Liability protection applies when CalEMA deploys volunteers

Rapid Assessment:

State of Development prior to Sept 2010

- **National guidelines (basis of operations)**

- **Initial training delivered to Building Control Officials and some engineers**
 - *Process Management and Evaluation Procedures* modules
 - Dunedin (June 2009), Christchurch (June 2009), Wellington (September 2009), Hawke's Bay (April 2010) and Waitakere (August 2010)
 - USAR Engineers (June 2010)

Detailed Engineering Evaluation: State of Development prior to Sept 2010

- Had yet to be specifically worked on
- General expectation that engineers would draw upon and adapt standard evaluation methodologies (NZSEE 2006) or use international documents (eg. US FEMA 306, 308, 352)

Implementation of Rapid Assessments – CCC, 4 Sept 2010

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Overview

- Rapid assessments of all blocks within the four avenues cordon (initial sweep Sunday 5th), followed by principal arterial routes (Monday 6th and Tuesday 7th)
 - Followed by further Level 2 assessments and street assessments by senior engineers prior to cordons being reduced to local barricades

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Worst affected residential properties in the eastern suburbs commenced Wednesday 8th

Implementation of Rapid Assessments (2) – CCC, 4 Sept 2010

Assessment Teams (CBD and Arterials)

- Level 1 Assessment teams comprised 1 Engineer, 1 Council Building Control Officer (or CCC Response Team member) and 1 NZ USAR Rescue Technician
- Level 2 teams comprised 2 Engineers, 2 Council Building Control Officers and 1 NZ USAR Rescue Technician

Implementation of Rapid Assessments (3) – CCC, 4 Sept 2010

Placards, Forms and Recording

- Placards as per August 2009 NZSEE Guidelines
- Forms as further developed following September 2009 Padang deployment
 - Incorporation of Level 2 Usability Categories
- Residential placards and forms modified to reflect health risk concerns (sanitation)
- Data management systems that built upon version developed in Padang

Implementation of Rapid Assessments (4) – CCC, 26 Dec 2010

- No declaration of emergency led to uncertainty of process within and across agencies
 - National process only applies in a declared emergency situation
 - Limited engineering input due to absence of liability cover and holiday period
- Several processes were initiated, including versions of the process used in September
- Dangerous Buildings provisions of the Building Act finally used

Implementation of Rapid Assessments (5) – CCC, 22 Feb 2011

Commercial

- A number of key learnings from September were successfully implemented
 - Particularly management of the process, co-ordination of resources, integration with engineers working for building owners
- Continued lack of clarity on the meaning of the placards for the public

Implementation of Rapid Assessments (6) – CCC, 22 Feb 2011

Residential

- Residential assessments were a large operation
- Major achievement for all involved
- Co-ordination of structural and geotechnical evaluations in the Port Hills was lacking
- The focus on posting principally only Red placards in the interests of time left some uncertainty for houses with partial damage

Main Shortcomings Identified (1)

Rapid Assessments

- Insufficient numbers of trained engineers and building officials
- Field guidance to assist assessors not available
- Yellow placards didn't allow for clear indication of restricted access areas
- Public communications around placards not developed

Remember



‘Inspected’
does not mean Safe!!

INSPECTED

NO RESTRICTION ON USE OR OCCUPANCY

This building has received a brief inspection only. While no apparent structural or other safety hazards have been found, a more comprehensive inspection of the exterior and interior may reveal safety hazards.

- Exterior Only
- Exterior and Interior

Facility/ Tenancy Name and Address

Please ensure the owners are advised of this notification. Owners are encouraged to obtain a detailed structural engineering assessment of the building as soon as possible. Report any unsafe conditions to the Territorial Authority. Subsequent events causing damage may change this assessment. Re-inspection may be required. Secondary damage (partitions, windows, fittings and furnishings) may be hazardous. Electrical and mechanical equipment, gas connections, water supplies and sanitary facilities have not been inspected.

Do Not Remove this Placard. Placed on Behalf of the Civil Defence Emergency Management Controller Under the Authority of the Civil Defence Emergency Management Act 2002

This facility was inspected pursuant to the Civil Defence Emergency Management Act 2002

Inspector ID:

Acting under the authority of the Civil Defence Emergency Management Controller:

Date: _____

Time: _____

Main Shortcomings Identified (2)

Transition and Detailed Evaluations

- Transition arrangements from declared emergency to 'business as usual' not developed
- No ability for Councils to require owners of green placarded buildings to obtain a Detailed Engineering Evaluation
- Detailed Engineering Evaluation technical procedures not prepared

Significant Aftershocks

Previous Expectation

- Typically up to one magnitude less, with corresponding reduction in intensity
- Same magnitude and comparable intensity possible but uncommon
- Similar directionality
- Large aftershocks most likely to occur within several weeks of mainshock

Significant Aftershocks (2)

Reality of 22 February 2011

- Generated significantly greater horizontal and vertical accelerations than the original event
- Different directionality of shaking
- Occurred many months after the original event

Subsequent Events & Developments

Placarding following other hazard events

- Central Hawke's Bay floods (April 2011)
- Nelson-Tasman flooding and landslides (December 2011)

Developments

- Detailed Engineering Evaluation methodologies were developed by the Engineering Advisory Group

Subsequent Events & Developments (2)

Interaction with Californian Agencies

- US Applied Technology Council visit and review (June 2011)
- Discussions with Californian Emergency Management Agency and ATC (August 2012)

Detailed Engineering Evaluation Procedures

GEN.BRU.0001.33

Detailed Engineering Evaluation Procedures

Purpose

- inform decisions by owners about the continued use of their buildings
- provide a starting point for decisions on any repair work to be carried out; and
- ascertain the state of buildings generally following the emergency phase

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Focus

- Understanding the likely performance in future earthquakes

Detailed Engineering Evaluation Procedures (2)

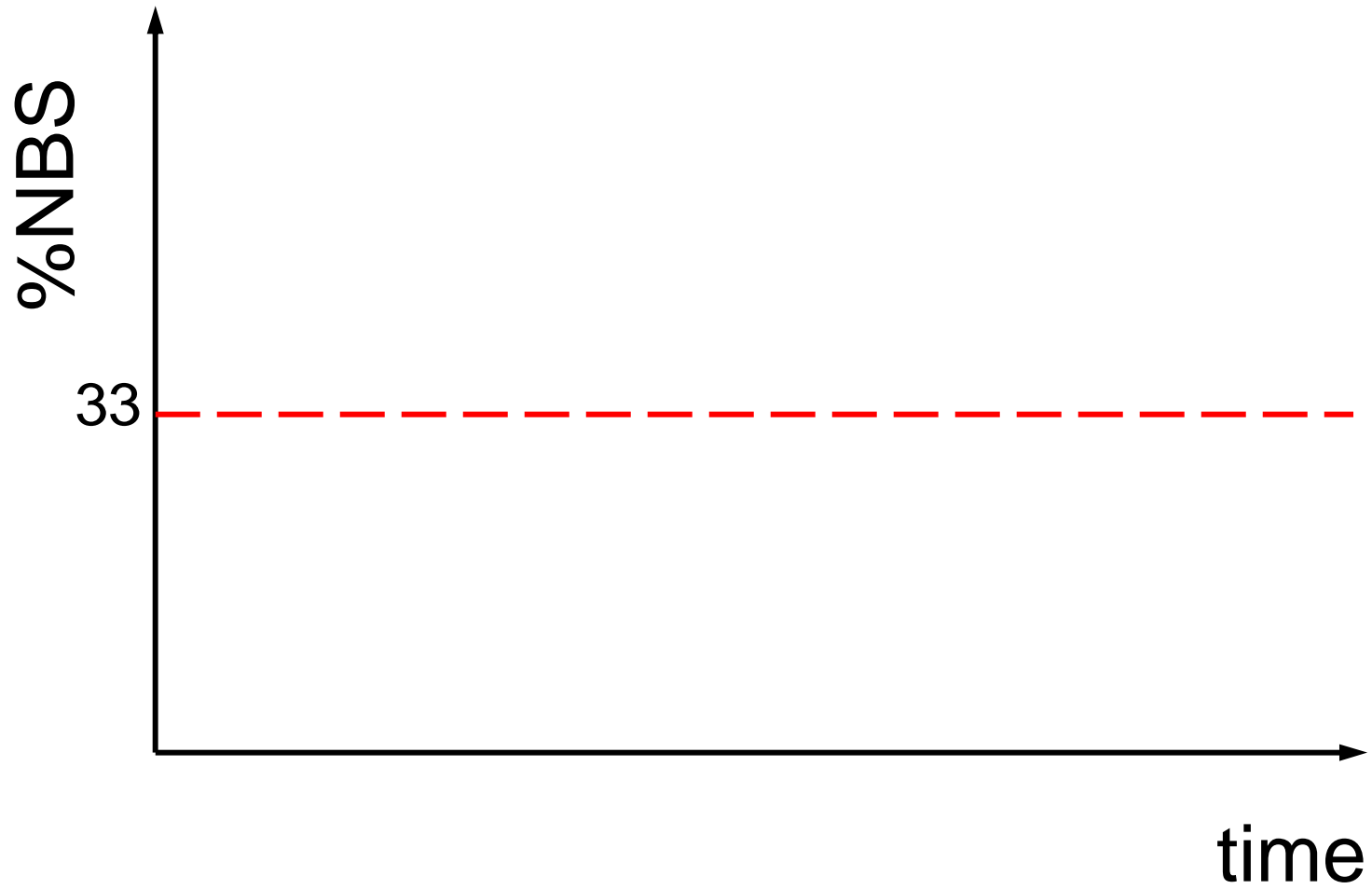
■ Qualitative assessment

1. Review original documentation; identify areas of vulnerability
2. Inspect the building, focusing on overall collapse mechanisms as well as direct life safety hazards

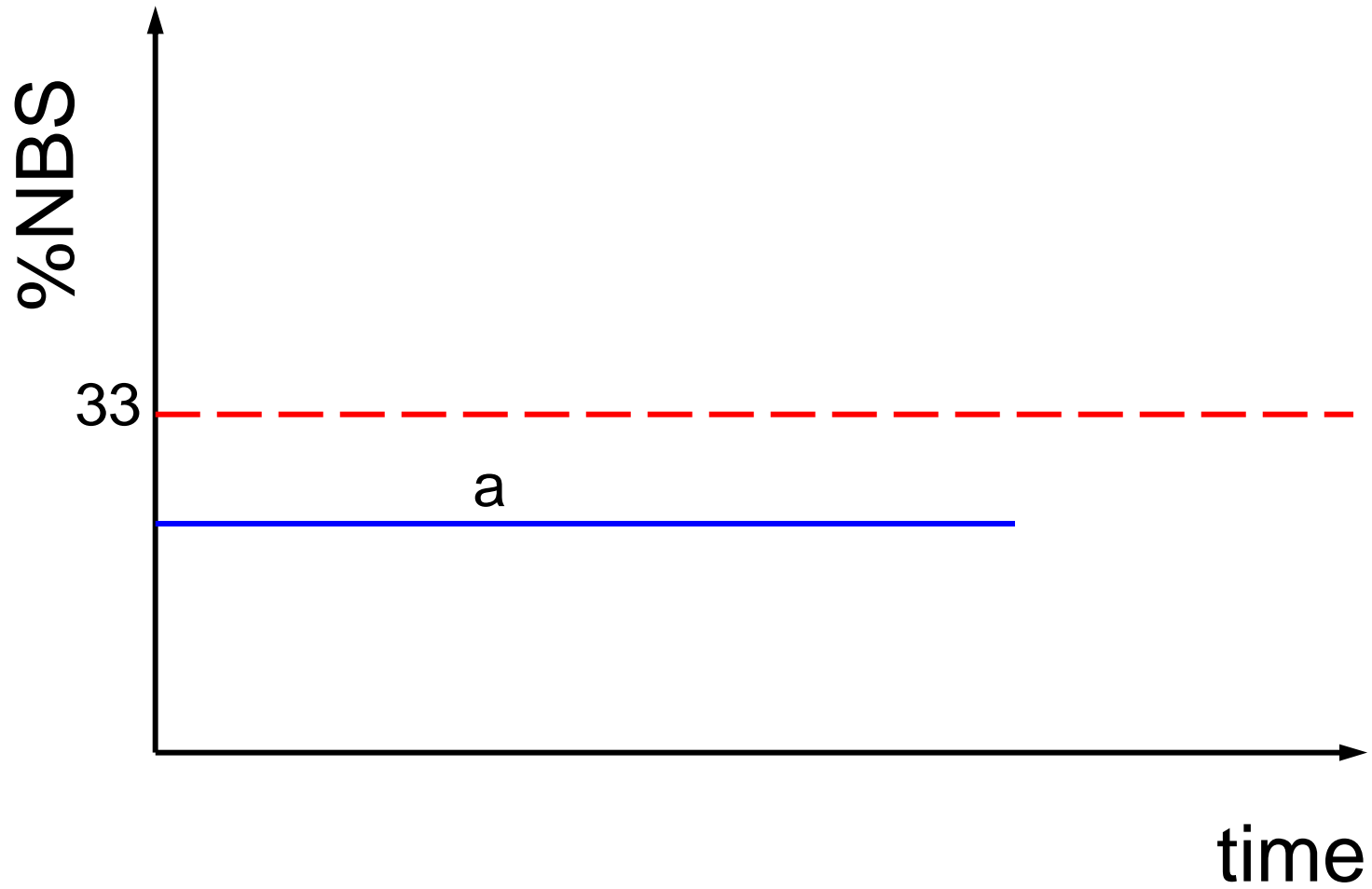
■ Quantitative assessment

- Where either significant damage or little damage but <33% of New Building Standard

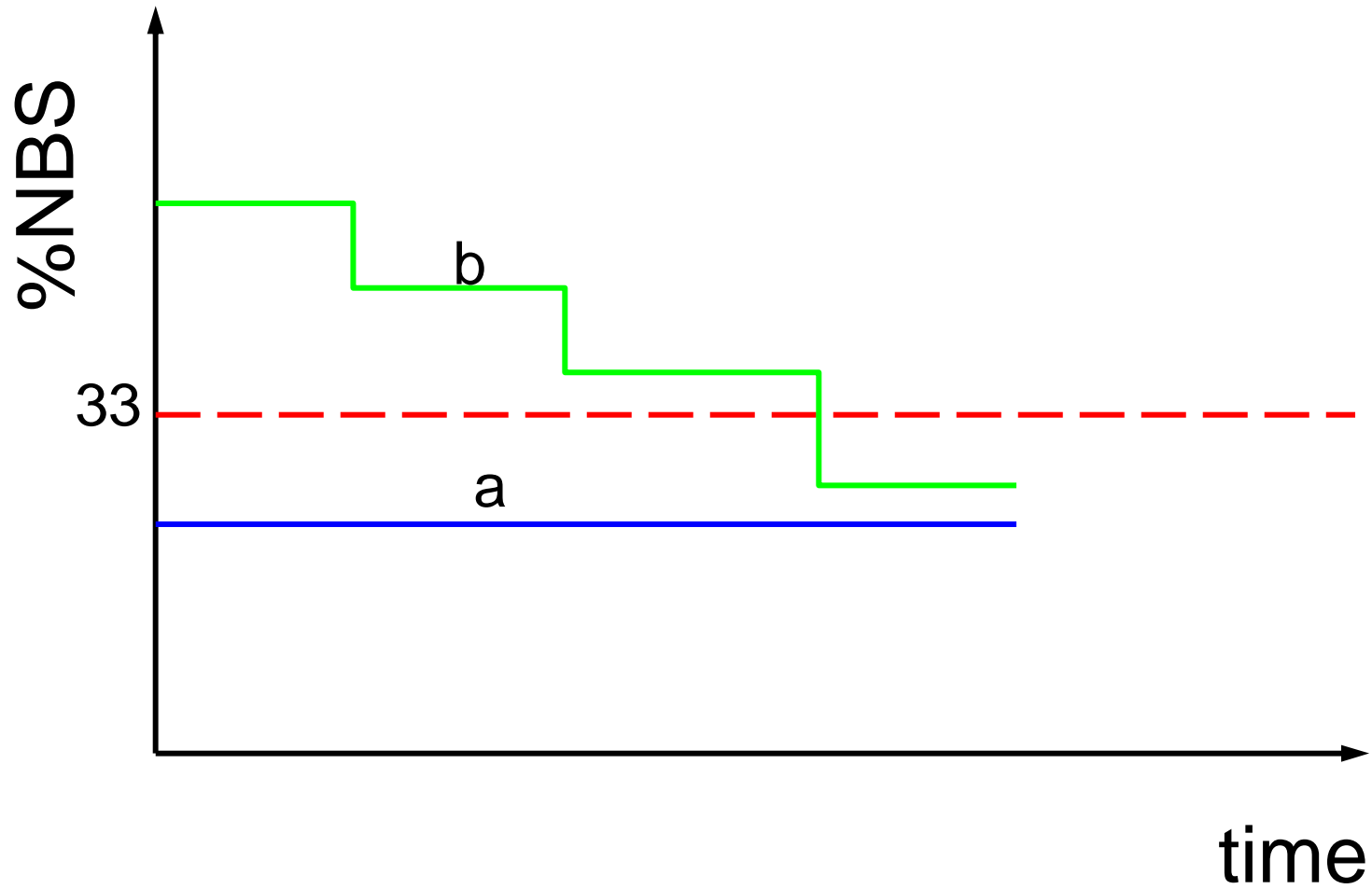
Building Status



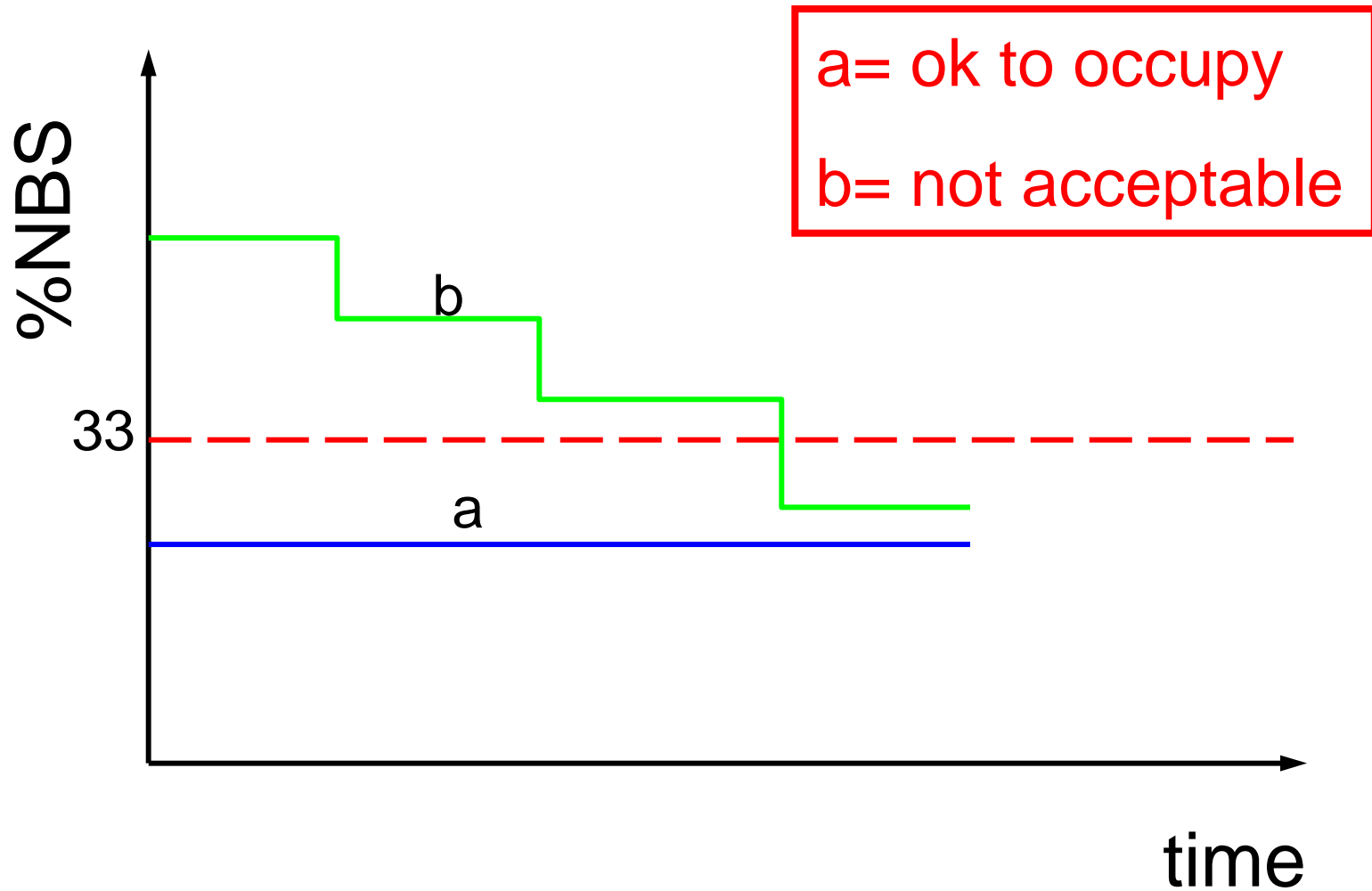
Building Status



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Building Status



Interim Use Evaluation Developed

- **Intermediate step prior to a DEE**
- **Takes the Level 2 Rapid Assessment one stage further to check that there is no significant hidden damage that may**
 - impair the overall capacity of the building
 - represent life safety hazards from toppling, critical elements (eg. stairs) or neighbouring buildings

Interim Use Evaluation Developed (2)

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- **Interim Use Evaluation requires a qualitative review:**
 - Identify damage
 - MUST sight/understand load path
 - MUST determine damage/no damage
 - Intrusive investigation if necessary – eg cracked walls
- Identify Critical Structural Weaknesses

Interim Use Evaluation Developed (3)

- **Not to be used for unreinforced masonry buildings unless strengthened above earthquake prone levels**
 - DEE required for unreinforced masonry buildings not meeting this requirement
 - Careful check of parapets and floor-to-wall connections required for all unreinforced masonry buildings

Future Arrangements

Core Issues to be Addressed

- **Goals and Objectives**
 - Scope of Rapid Assessment - rapidity vs thoroughness
 - Re-occupancy criteria
- **Roles and responsibilities**
 - Preparation
 - Activation and response
 - Transition to normal regulatory arrangements
- **Training and resourcing for Rapid Assessment**
 - Capability and capacity objectives
 - Annual/ ongoing maintenance costs

Contrasting Scenarios to be Considered in Addressing Issues

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- **Metropolitan centre**
 - CBD with mix of older buildings and more modern multi-storey buildings
 - large residential population
- **Provincial centre**
 - predominantly low-rise older buildings

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need to reflect on the different public risk, economic implications, and assessment resources required for each scenario

Future System and Arrangements

Key Components (NZSEE, 2011)

GEN.BRU.0001.49

1. Appropriate legal mandate (building legislation)
2. Central government agency providing a focal point, guidance and support for preparedness activities
3. Criteria and process for building re-occupancy established
4. Local authorities prepared to set up and manage a building evaluation operation (with national support)
5. Appropriate numbers of trained and warranted building professionals
6. Effective mobilisation arrangements for warranted building professionals (locally and nationally)

Future System and Arrangements

Key Considerations (1)

Whether a rapid evaluation system based on damage assessment should incorporate any elements of residual capacity assessment?

Future System and Arrangements

Key Considerations (2)

Making appropriate allowance for the possibility of large aftershocks with the potential for

- greater intensity of shaking
- different directionality of shaking

Future System and Arrangements

Key Considerations (3)

Clarifying Occupancy Criteria and Process

- What does 'occupiable' or 'usable' mean?
- The concept of 'interim occupancy'
- Avoiding placing 'Inspected' placards on buildings of known low capacity (EQ Prone buildings)
- Requiring owners of 'Inspected' placarded buildings to move swiftly to get Detailed Engineering Evaluations undertaken
- Proposal of 'White' colour for this placard

Future System and Arrangements

Key Considerations (4)

The building evaluation system must be integrated with both Earthquake Prone Building Policy requirements and Dangerous Building provisions

- There needs to be a priority given to restraining masonry parapets and addressing vulnerable elements
- The register of earthquake prone buildings held by each council should ideally extend to a summary of the structural capacity of all significant structures

Future System and Arrangements

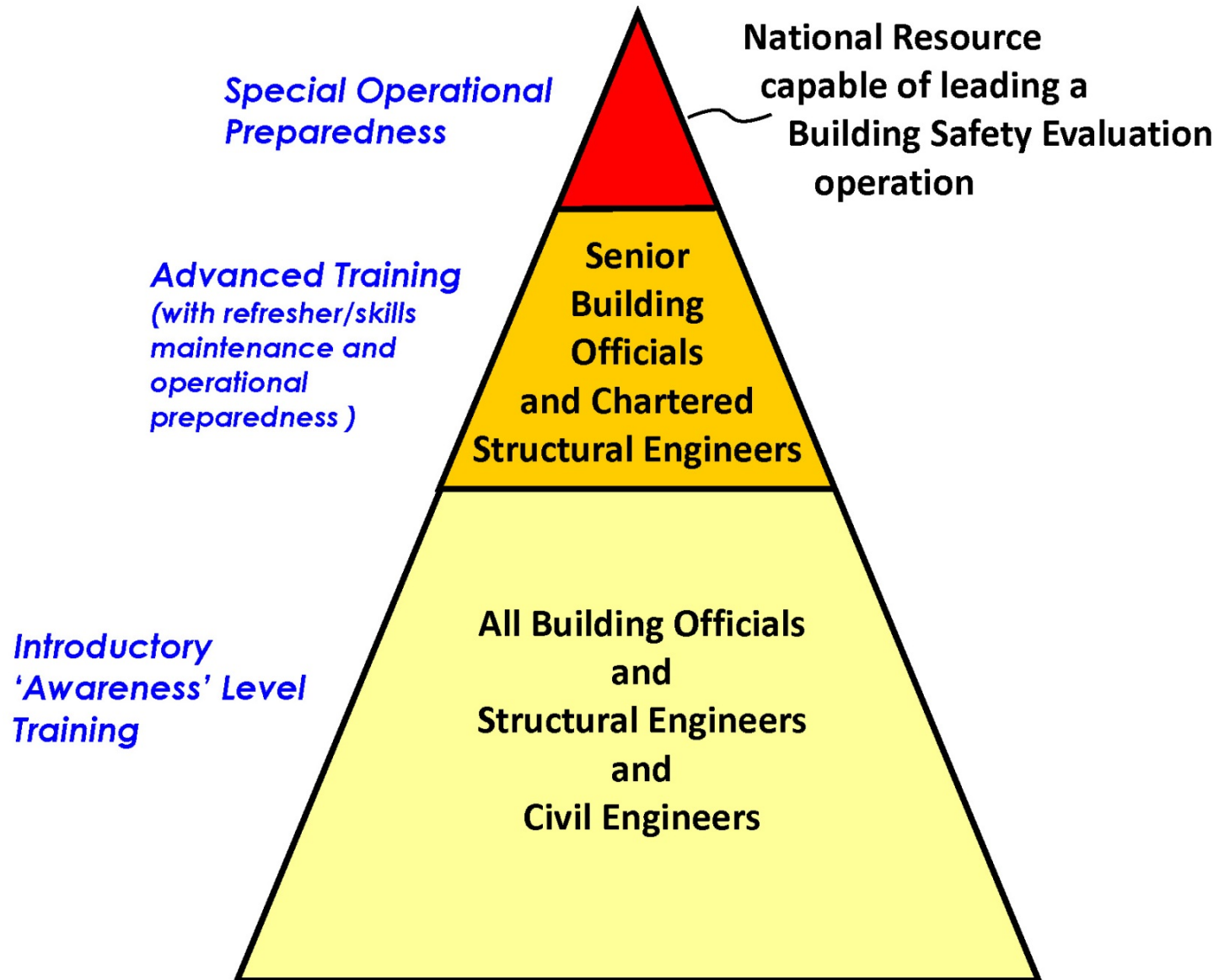
Key Considerations (5)

Training & Accreditation

- Training outcomes should be linked with operational accreditation and liability cover
- Capability and capacity objectives to be carefully considered

Capability Objectives

GEN.BRU.0001.55



Future System and Arrangements

Key Considerations (6)

Building Information Management

- Unique identifiers required for each land parcel, each building and street address within property records
- Placarding status of buildings to be readily available
- Structural drawings and relevant information (including previous capacity assessments) to be readily accessible from council records

Future System and Arrangements

Key Considerations (7)

Allowance for the differences between rapid building evaluation operations in commercial and residential areas

- Issues of sanitation require more specific consideration in residential situations (earthquake and flood events)
- Enable better co-ordination of structural and geotechnical processes (earthquake or flooding and landslip/ rockfall)

Future System and Arrangements

Key Considerations (8)

Linkages with Civil Defence Emergency Management Act obligations

- Critical Facility and Lifeline Utility operators have a requirement to plan to continue to operate to the fullest extent possible
- This implies they should have their own specific arrangements with professional engineers for post-disaster assessments

Summary Comments

1. NZ's post-disaster building evaluation process is based on international best practice
2. These arrangements were under development at the time of the September 2010 earthquake
3. The February 2011 earthquake represented an extremely large aftershock that would pose a significant challenge for any post-disaster building management system

Summary Comments (2)

4. The main shortcomings and gaps identified are in the areas of
- ❑ regulatory context and provisions
 - ❑ the communication of risk, expectation and process to the public
 - ❑ capability and capacity, and
 - ❑ technical procedures following the emergency phase

Summary Comments (3)

5. Many of the technical procedures needed to address the gaps have subsequently been developed
 - ❑ further enhancement through international collaboration planned

Summary Comments (3)

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 - ❑ further enhancement through international collaboration planned
6. A legal framework that provides an effective linkage between post-disaster and normal regulatory processes is a fundamental requirement