STUDY REPORT

SR 338 (2015)

Accessible Egress Pilot Workshops Summary

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Preface

This is the second of a series of reports prepared during research into accessible emergency egress. This is a summary of the results of Pilot Workshops and initial interviews.

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This work was funded by the Building Research Levy.

Note

This report is intended for regulatory authorities, fire researchers, scientists, engineers and architects.

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Units

Standard International (SI) units are used throughout.

Accessible Egress – Pilot Workshops Summary

BRANZ Study Report SR 338

AP Robbins and J Warren

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Abstract

This project addresses three interrelated issues in the New Zealand context of accessible means of building egress:

1. Egressibility,
2. Demographic, technological and social trends, and
3. Lack of sufficiently-nuanced building user characteristics data and other information.

The results from a series of Pilot Workshops are summarised and analysed in relation to the current New Zealand Building Code, standards requirements and documented guidance.

The results indicate that the issues related to occupant egressibility expectations and experiences include:

- Assumptions of areas of refuge being located at all/any stairs or in front of all/any elevators. This may lead to individuals needing to be searched for or overlooked and leads to inconsistent identification of areas of refuge and instructions for use.
- The need for consistent training of wardens.
- The need for familiarity of users and operators with evacuation assistance devices.
- A general level of misunderstanding about some fire safety systems and how they work. However, there being a generally positive view of their presence. For example, believing a sprinkler system operates throughout a building based on a misrepresentation in movies and other entertainment may cause undue worry.

Suggestions for addressing these items include:

- Providing opportunities for experience of and familiarisation with the use of intended evacuation assistance devices in non-emergency situations. This includes experiential planning for what happens at the bottom of the stairs, etc. where the person's personal mobility device is no longer with them.

- Including individuals who may require assistance in evacuation drills, so that both users and operators of intended evacuation devices gain experience of and confidence in the equipment and each other.
- Additional requirements to complement current regulation for the clear identification of areas of refuge and provision of instructions for their use.
- Public education on the identification of areas of refuge areas and intended use.
- Standardised training of wardens, including how to offer and provide assistance to accommodate the range of needs of building occupants, and information to collect and provide to the Fire Service.
- Public education about what to expect from a warden and general information on offering and providing assistance to others.

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1. INTRODUCTION

This project addresses three interrelated issues:

Egressibility:

The need for accessibility for emergency egress has been identified internationally[1]. In New Zealand, accessibility requirements are currently specified for some buildings, but these do not include requirements for emergency egress. Accessibility requirements are mandated by New Zealand building regulations for buildings that are accessible to the public[2]. However, these requirements do not extend to situations of emergency egress from the same buildings such as evacuation plans, management, exit ways, etc. (see Paragraph 1.4.5.2, NZS4121 2001). Emergency egress may be needed in a variety of circumstances including after an earthquake where the structure is intact and during a fire event or a practice evacuation drill. A common method of providing access in multi-storey buildings is the installation of elevators but these are typically not available for evacuation in the event of a fire or earthquake. This research focuses on fire safety as a case study for safe egress in an emergency situation. Fire safety is often the basis for emergency egress design and management, and then implicitly assumed to be sufficient for all emergency scenarios.

Demographic, technological and social trends:

Accessibility is considered in the context of the characteristics of the intended users of a building. People's physical capabilities, for instance, potentially affect their safe egress from a building in emergency if the building is not designed with consideration of the range of characteristics of the intended users. The distribution of such characteristics is likely to alter with changing demographics of the New Zealand population (e.g., age), medical/technological advances and increasing housing density in some urban areas. As the population ages, there will be a greater proportion of people over 65 years and, therefore, potentially more people with physical and other impairments. Developments in medicine and technological mobility and sensory aids, coupled with changing personal aspirations, supported by changing health policies, may also affect the distribution of building occupant/user characteristics. For example, by enabling or encouraging more people to live independently for longer (rather than in aged care and other specialised care facilities). Increasing pressure for high density housing (e.g., in Auckland), leads to more people living in the city centre in multi-storey buildings. This may also affect the distributions of building user characteristics and the design and use of residential, community and other buildings.

Lack of sufficiently-nuanced building user characteristics data and other information:

Buildings have been designed for life safety based on outdated and/or anecdotal expectations of an average healthy young adult's ability to exit a building in an emergency. Unfortunately, available datasets tend to focus on the healthy adults' ability (e.g., their moving speed, obstacle negotiation, etc.[3]) rather than a distribution of ability as a function of particular user sectors.

The New Zealand 2006 Disability Survey (NZ Statistics, 2007) provides an important dataset about the distribution of disability in the population. However, because it

[1] For instance, see http://www.access-board.gov/evac.htm, www.nfpa.org/disabilities, ISO 21542:2011 Building construction – Accessibility and usability of the built environment, (U.S.) National Fire Protection Association (NFPA) Fire Protection Research Foundation (FPRF) research agenda.
[2] Accessibility for residential housing is voluntary.
[3] For example, use of an assumed single value of travel speed of 1 m/s indicated for the calculation of exposure to radiation of egressing occupants (Paragraph 3.6.4 of the commentary for VM/2 including up to Amendment December 2013, etc.)

potentially underestimates disability levels in New Zealand, the data may not be appropriately applied to building design. For instance, a self-reported 17 percent of the population having disabilities may be an underestimate as individuals with reduced capabilities may not have self-identified as 'disabled'. Two groups may have under-reported their disabilities and are therefore not captured in the data. These include older people and individuals with medical- or situational-induced incapacities of a temporary or short-term nature. Older people typically see their impairment as part of the ageing process. Individuals with a temporary incapacity (e.g., broken leg, pregnancy, parent with a pram, etc.) may not identify as disabled. Thus, use of such data as an estimate of disability in the design of accessibility and egressibility of buildings is problematic.

New Zealand currently leads the world in performance-based fire engineering (Meacham, 2011). However, development of performance-based or even prescriptive requirements for accessibility and egress is limited both here and internationally. This is because of the lack of information/data to adequately characterise and quantify occupant characteristics in a manner that facilitates development of regulations around emergency egress.

1.1 Objectives

The overall project objective is to understand the population of New Zealand and how buildings are used in emergency situations, now and in the future. As multi-use, multi-storey buildings become popular, being used by a population with a wider range of capabilities, the need exists to inform building design tools, guidelines, standards and regulations.

The Pilot Workshops are the second instalment of the overall project. The Pilot Workshop objectives are to contribute towards:

1. Identifying the full design description of the New Zealand population:
    a. In particular, the key design metrics to be used to fully describe an intended building occupancy that includes all expected ranges of mobility and sensory capabilities, and
    b. Reasonable ranges for each of these design metrics.
2. Identifying the New Zealand context (if there are New Zealand-specific considerations to include in the assessment).
3. Summarising the current building requirements and best practice internationally, and evaluate how effective and/or practical and appropriate these are for the New Zealand context.

1.2 Project Scope

Intended overall project outcomes:

1. More informed lobbying by groups/organisations through provision of a resource (e.g., published project findings and recommendations in summary form). Lobbying may lead to change such that emergency egress accessibility requirements will be more appropriate and clearly addressed in regulations and fire safety requirements relating to accessible emergency egress will be addressed.
2. Identifying economic benefits arising from a reduction of emergency egress-related injuries and deaths and improved usability of buildings.
3. Social benefits arising from buildings that are more appropriately designed to preserve life by allowing more efficient egress for building users and occupants.

4. Knowledge and integrated design through improved understanding of occupant characteristics and potential accessible fire safety solutions leading to improved practice in fire safety design and accessible-building design.

Project Intent:

Completion of a successful project will be realised by the project's reported results being publicly available and used by multiple parties throughout the building industry and wider community. They will help to promote and implement positive change in building design attitudes and, ultimately, regulations for appropriate and functional egress design based on intended building user characteristics.

1.3 Report Scope

This report presents the research methodology, results and analysis of the Pilot Workshop portion of the overall research project.

The rest of Section 1 discusses the availability of data about the emergency building egress capabilities of the New Zealand population. This includes the current egressibility-related building features, systems or procedures included in codes, standards or guidelines in New Zealand and selected international jurisdictions. This range of requirements and guidance is used as a basis for developing the framework for analysing research data (described in Section 3).

Section 2 describes the research approach, with data collection through a mix of semi-structured interviews and Pilot Workshops to:

(i) Identify currently used and relevant data/measures, collect new data as a basis for mapping building occupant/user and institutional experiences, capabilities and expectations, and potentially inform performance-based design,

(ii) Rank building design and evacuation plan options, and

(iii) Identify gaps in data. The mapping framework is described in Section 2.1.6.1.

The analysis section of the report (Section 3) maps workshop-generated data using this framework. It expands the list of potential egressibility-related building features identified by the research participants and evident in egressibility-related code, standard and guidance requirements in New Zealand and selected international jurisdictions. The mapping exercise shows workshop participants' responses to these features and their place in any suggested solutions in tabular form. A more detailed description of participants' views is also included. A comparison of the features raised by research participants and those in code or standard requirements or guidance shows overlaps and gaps.

Section 4 summarises key workshop and interview themes. This includes current population trends, accessibility and egressibility rights, explanations for identified legislative shortcomings, and how research participants would anticipate responding to an emergency event. The section also includes a summary of their suggested solutions to identified problems, including the application of universal design principles, and disability awareness-raising and education. It closes by addressing some identified gaps in New Zealand regulations and guidelines by outlining international requirements or guidance about some concepts raised by participants and not required in New Zealand.

The final section, Conclusions, outlines some possible approaches to address identified problems.

1.4 Summary of the New Zealand Context

There is limited available data to characterise the emergency building egress capabilities of the New Zealand population. What is available does not include comprehensive

distributions of metrics for performance of building users/occupiers and, therefore, is not applicable to performance-based design and assessment.

Metric values that are more readily available in the literature related to emergency egress are sourced from a mix of:

- Controlled experiments with (e.g., some experiments have used irritant smoke) or without (e.g., Boyce et al., 1999) elements of a fire;
- Announced evacuation drills (e.g., Peacock et al., 2012); and
- Fire incident case studies (e.g., Averill et al., 2005).

Variations in data sets have been shown for different individuals with different occupant characteristics (e.g., Peacock et al., 2012). Therefore the source of the data sets and influence of the potential variability of the data sets must be taken into account for each intended application.

Actual emergency data is most desirable and might provide the most realistic and accurate indicator of behaviour. There is also the potential to utilise a wider range of characteristic metric data sets that are already collected for a variety of reasons other than emergency egress. Collation of this diverse data on the characteristics of our population may provide a clearer description of the distribution of capabilities in order to inform emergency building egress. One way to do this is to take a snapshot of related characteristics from a collage of metrics collected by others to describe the characteristics of their respective interest groups.

Recommendations from an earlier study (Robbins and Buckett, 2014) for research in alignment with the concept of utilising data sets from other focuses in our communities includes:

1. Collect and collate data sets on population mobility and comprehension, etc. from groups and organisations throughout our communities.
2. Establish levels of capability based on the combined data sets for modelling emergency egress scenarios. Identify the key metrics and combinations of metrics for more detailed consideration. Appropriateness might be assessed by:
    a. Comparison of distributions, partial distributions, value ranges and average values reported from emergency egress drills or controlled experiments.
    b. Use of the combination of metric distributions in modelling of well-documented case studies.
3. Compare New Zealand values of the identified metrics to international values to assess whether there is a correlation between the identified metrics and fire incident statistics.

1.4.1 New Zealand Egressibility-Related Building Requirements and Guidelines

A summary of the overall requirements and exclusions to incorporate accessibility into egressibility as currently applied in New Zealand include:

- Ensure that people with disabilities are able to enter and carry out normal activities and functions within buildings. (NZBR 1992, Objective D1 – Access Routes, Objective D1.1[c]). It is noted that accessibility for private houses and private apartments is voluntary.
- “Buildings must be provided with means of escape to ensure that there is a low probability of occupants of those buildings being unreasonably delayed or impeded from moving to a place of safety and that those occupants will not suffer injury or illness as a result.” (NZBR 1992, Clause C4 – Movement to Place of Safety, Functional Requirement C4.2)

- The New Zealand Regulations (NZFSR 2006) require all evacuation schemes to have place(s) inside the building where persons with disabilities may wait for assistance during an evacuation.
- "No problems of fire safety and evacuation from a building shall be a cause to limit or prevent any person with disabilities from entering or carrying out normal activities and processes within the building, or any part of it, which the person would otherwise be permitted to enter or use." (NZFSR 1992 [now superseded by the 2006 version])
- An owner of a relevant building is not required to provide and maintain an evacuation scheme for the building if (NZFSA 1975):
    a) The building is used for a purpose specified in Section 21A(1)(b) or (c); and
    b) The building has an automatic sprinkler system.
- The Fire Safety Evacuation of Buildings Regulations require that access for people with disabilities shall not be denied on the grounds that there are problems with fire safety and evacuation from a building. Refer to Appendix A (NZS 4121 2001) [Interpretation: Access for all, even if there are problems or limitations of the fire safety and evacuation for all].

Sources used in these examples of New Zealand egressibility-related requirements and guidelines are summarised in Appendix D.1.

Potential features relating to egressibility were submitted for consideration during the public consultation-forming part of the review of the New Zealand Building Code (DBH 2007, page 32). A number of design solutions were proposed to address the issue of accessible emergency egress, including:

- Fire-safe sprinklered areas.
- Fire safety management plans.
- Wide, unobstructed fire-rated egress with all doors two-way operable.
- Wide doorways (860 mm minimum).
- Multi-use pathways.
- Stair evacuation chairs:
    - All commercial multi-storey buildings with lift and stair access only (no ramps throughout) having evacuation chairs on every elevated floor.
- Ramps.
- Mechanical/hydraulic external lift systems alongside exterior stairwells.
- Protected refuge areas.
- Fire-resistant lifts in multi-storey buildings.
- Accessible safe accommodation by fire exits.
- Visual warning alarms.
- A minimum of two external exits.
- All buildings having a minimum of two wheelchair-accessible and usable emergency exits.
- Education about emergency evacuation, which might include nominating able-bodied people to help people with disabilities or informing people about safe zones for them within emergency egress paths.

- Universal design for all buildings, including accessible egress paths.

A summary of New Zealand egressibility-related Building Code requirements, standards and guidance are provided in Table 1.

Table 1: Summary of New Zealand egressibility-related Building Code requirements and guidance.

Building Features	Example Components or Features	Summary of New Zealand Regulations, Requirements, Standards or Guidance
Alarm	General	Alerting devices are to have an audible and visual alerting component. (NZS4121 2001)
	Sounder	The audible aspects of the alerting device are to comply with the requirements of NZS4121. (NZS4121 2001)
	Visual	The visual aspects of the alerting device are to comply with the requirements of NZS4512. (NZS4121 2001)
Wayfinding		The nominated 'means of escape' route is to be clearly indicated at the turnstile or trolley trap so that people with disabilities do not attempt to use the turnstile or trolley trap in an emergency. (NZS4121 2001)
Egress routes	Surface continuity	
	Door opening force	It is highlighted that the force necessary to keep fire and smoke control doors shut and so be effective in a fire may not be easily overcome by people with disabilities. Studies suggest that a force of 70 N could be handled by up to 80% of the people with disabilities and a force of 21 N could be handled by 95% of the people with disabilities. (NZS4121 2001) The force required to push or pull open a non-fire door shall not exceed the following (NZS4121 2001): a) Exterior hinged door: 38 N; b) Interior hinged door: 22N; c) Sliding or folding doors: 22N. The force required to push or pull open a fire door or smoke control door shall not exceed the following, as applied at the latch stile of a hinged door (C/AS5, Paragraph C6.1.3 and excludes Risk Group SI or power-operated doors): a) 67 N to release the latch, b) 133 N to start the motion of the door, and c) 67 N to open the door to the minimum required width.
	Stair specifications (forming part of an exit)	The riser of the bottom step of any flight of stairs is to not encroach into corridors so that the effective minimum width of the corridor on an accessible route or means of escape in fire is not compromised. Where stairs do encroach, they are to be protected by a barrier or a return wall indicated by a change in surface texture of the floor. (NZS4121 2001) Landing lengths of at least 1200 mm (including mid-flight landings, where on a straight or zigzag set of stairs) are required to ensure that wheelchair users may be safely carried down (up) stairs in their own wheel chairs in an emergency (generally the preferred evacuation method). This length ensures both a safe resting place for the wheelchair user and enables other people to pass safely. (NZS4121 2001)
Stay in place/wait for assistance	Areas of refuge	All evacuation schemes are to have place(s) inside the building where persons with disabilities who may be unable to evacuate may wait for assistance during an evacuation. (NZFSR 2006) The New Zealand Regulations require all evacuation schemes to have place(s) inside the building where persons with disabilities may wait for assistance during an evacuation. (NZFS 2014, Q3.7, p19) This place can be any nominated space inside the building (for example stairwell, reception), but does not need to be a *place of safety* inside. This is a requirement for all evacuation schemes, even if there are no permanent occupants who are persons with a disability. There should be an adequate number of nominated places for persons with disabilities to gather for the use and occupancy of the building. This may mean that for a multi-storey building, there is to be a number of places in the building for

		persons with disabilities to gather (e.g., in a stairwell on each level). Landing lengths of at least 1200 mm (including mid-flight landings, on a straight or zigzag set of stairs) are required to ensure that wheelchair users may be safely carried down (up) stairs in their own wheelchairs during an emergency (generally the preferred evacuation method). This length is to provide a safe resting place for the wheelchair user while other people pass safely. (NZS4121. 2001)
	Rescue provisions	Landing lengths of at least 1200 mm (including mid-flight landings, on a straight or zigzag set of stairs) are required to ensure that wheelchair users may be safely carried down (up) stairs in their own wheel chairs in an emergency (generally the preferred evacuation method). This length ensures both a safe resting place for the wheelchair user and enables other people to pass safely. (NZS4121. 2001)
Evacuation scheme/ fire safety plan		An evacuation scheme is required for a building that is used for one or more of the following purposes (NZFSR 2006): • the gathering together, for any purpose, of 100 or more persons • providing employment facilities for 10 or more persons* • providing accommodation for more than 5 persons (other than 3 or fewer household units)* • a place where hazardous substances are present in quantities exceeding the prescribed minimum amounts (see Appendix B for a list of these amounts), whatever the purpose for which the building is used • providing early childhood facilities (other than in a household unit) • providing nursing, medical or geriatric care (other than in a household unit) • providing specialised care for persons with disabilities (other than in a household unit) • providing accommodation for persons under lawful detention (other than home detention, community detention or parole). *If the building is used for either providing employment facilities for 10 or more persons or providing accommodation for more than 5 persons (but not both) of these two purposes, and has an automatic sprinkler system (as described in Regulation 16), refer to the section below 'Notice to the National Commander that an evacuation scheme is not required'. (NZFSR 2006) The owner of a relevant building is not required to submit an application for approval of an evacuation scheme to the Fire Service if the building (NZFS 2014): • has an automatic sprinkler system AND • is used for EITHER: ○ providing employment facilities for 10 or less persons, OR ○ providing accommodation for not more than 5 persons (other than 3 or fewer household units) The building must have an automatic sprinkler system and be used for either (but not both) of the two purposes above to fall within this provision.
	Listing of evacuation equipment, if provided	The requirement for providing a list of evacuation equipment in the building (if any) pertains to (NZFS 2014): • evacuation chairs • hoists • wheelchairs • stretchers • mobile cots. This listing is not intended to include things like access ramps.
	Evacuation training programme	An evacuation training programme is required and requirements for how the training is to be carried out are also to be provided. (NZFSR 2006) The evacuation training programme is to be carried out at least six-monthly. (NZFSR 2006) The evacuation training programme is to include details about how permanent occupants are trained and assessed including (NZFS 2014): • frequency of training • how occupants are alerted to a fire in the building • how occupants are informed of:

		○ the measures they should take for their personal safety once alerted to a fire ○ the need (if necessary) to evacuate to the place(s) of safety ○ where the place(s) of safety are and the fastest way to get to them • use of firefighting equipment (if any) in the building • use of equipment (if any) for assisting persons with disabilities to evacuate.
Definitions	Persons with a disability	A person: i. who has an impairment or a combination of impairments that limit the extent to which the person can engage in the activities, pursuits and processes of everyday life, including, without limitation, any of the following (NZFSR 2006): a. a physical, sensory, neurological or intellectual impairment: b. a mental illness; and ii. who is unable to sense or understand a fire alarm or leave a building, during a fire emergency, in a way that a person without the same disability would be capable of doing (NZFSR 2006); and iii. includes any person who considers that he or she would be unable to leave a building during a fire emergency by using its means of escape from fire (NZFSR 2006), iv. whose ability to use buildings is affected by mental, physical, hearing or sight impairment (*people with disabilities* definition in NZBC, 1992).

1.4.2 Other Egressibility-Related Building Requirements and Guidelines

A summary of the overall requirements to incorporate accessibility into egressibility as currently applied in selected international codes and standards include the following:

- Work continues on identifying suitable and effective Deemed-to-Satisfy building solutions to ensure equitable egress for people with disabilities. At this stage compliance with the relevant fire safety and egress provisions of the Building Code of Australia (BCA) ensures compliance with the Premises Standards (FRLI 2010) requirements. (AHRC 2013)
- Those responsible for buildings are encouraged to develop policies and procedures for emergency egress including, for example, Personal Emergency Egress Plans (PEEPS) for occupants with disability. (AHRC 2013)
- Not less than one accessible means of egress from an accessible space is to be provided. Where more than one means of egress is required from any accessible space, each accessible portion of the space is to be provided by not less than two accessible means of egress. (IBC 2012, Paragraph 1007.1). There are the following exceptions:
    - ○ Accessible means of egress are not required in alterations to existing buildings.
    - ○ One accessible means of egress is required from an accessible mezzanine.
    - ○ In assembly areas with sloped or stepped aisles, one accessible means of egress is permitted where the common path of travel is accessible.
- ‘Means of egress’ and ‘accessible route’ are separate terms. (ICC A117.1 2009)

Sources used in these examples of New Zealand egressibility-related requirements and guidelines are summarised in Appendix D, Section D.1.

A summary of selected international egressibility-related Building Code requirements, standards and guidance are provided in Table 8, Appendix D, Section D.2.

1.4.3 Summary

Potential egressibility-related building features, systems or procedures described in codes, standards or guidelines for New Zealand and selected international jurisdiction are summarised in Table 2. The selected international requirements related to egressibility (accessible considerations related to means of egress) and guidance is provided for a wider range of features than for New Zealand requirements. The selected international documents and requirements provide a basis to inform the discussions following the analysis of the collated Pilot Workshop findings. In Table 2, items with requirements that are included in the codes, standards or guidance are indicated with a tick (✓). Items that are not included are indicated with a circle (o).

Table 2: A summary of egressibility-related features included in New Zealand and a selection of international codes, standards and guidelines.

Building Features	Example Components or Features	Descriptions of Components	Information Present	
			Selected International Sources	New Zealand Sources
Alarm	General		✓	✓
	Sounder		✓	✓
	Visual		✓	✓
	Shaker		✓	o
	Pre-recorded voice notification		✓	o
	Live voice notification (i.e., using a PA system)		o	o
	NOT A BUILDING FEATURE		o	o
Wayfinding	General		✓	✓
	Emergency lighting		o	o
	Signage – exits, directions, schematic floor schemes	General	✓	o
		Colours and patterns	✓	o
		Words	✓	o
		Symbols	✓	o
		Tactile signs	✓	o
		Tactile maps & floor plans	✓	o
		Reflective	✓	o
		Backlit	✓	o
		Photoluminescent	✓	o
		Tactile walking surface	✓	o
		Identification of doors	✓	o
	Trained staff tasks	e.g., inform, usher, guide, direct others to assist or assign 'buddy systems', assist, etc.	✓	o
	NOT A BUILDING FEATURE	e.g., training of staff to support the provision and consistency of required trained staff tasks, etc.	✓	o

Egress routes	General		✓	o
	Corridor/aisle clearances		✓	o
	Surface continuity		✓	✓
	Doors		o	o
	Door clearances		✓	o
	Door operation	Manual, lever, button call, closer operation	✓	o
	Door opening force		✓	✓
	Door swing		✓	o
	Door swing clearances		✓	o
	Ramp specifications (forming part of an exit)		✓	o
	Stair specifications (forming part of an exit)		✓	✓
	Elevator specifications (forming part of an exit)		✓	o
	Platform lift specification (forming part of an exit)		✓	o
	Escalators and travellators (forming part of an exit)		✓	o
	Trained staff (direct others to assist, assist)		✓	o
	Assistance devices		✓	o
		Stair assistance device	✓	o
	Main access into the building		✓	o
	NOT A BUILDING FEATURE		o	o
Stay in place/wait for assistance	Areas of refuge		✓	✓
	Exterior area for assisted rescue		✓	o
	Signage for areas of refuge		✓	o
	Protected floor space		o	o
	2-way voice communication systems		✓	o
	Evacuation equipment		✓	o
	Rescue provisions		✓	✓
Evacuation scheme/ fire safety plan	General		✓	✓
	Listing of evacuation equipment, if provided		o	✓
	Evacuation training programme		✓	✓
Definitions	Persons with a disability		✓	✓
	Human abilities and associated design considerations		✓	o

Public education			✓	o

2. APPROACH

2.1 Methodology

The research project is designed to identify and collect data and focused solution examples where possible. The building design context is New Zealand focused, with international perspectives used to provide additional breadth. The project was structured around four phases:

- Initial literature review,
- Interviews, focus groups and Pilot Workshops,
- Post-workshop analysis, and
- Dissemination of results.

These are described in detail below.

2.1.1 Initial Literature Review

Previous research completed to contribute to this overall project comprised a literature review of the New Zealand and international research (Robbins and Buckett, 2014) that formed Phase 1. This review provided a basis for Phase 2, the interviews and Pilot Workshops, and a summary of potential solution approaches for use in Phase 3, analysis of interview and Pilot Workshop results.

2.1.2 Interviews, Focus Groups and Pilot Workshops

Semi-structured interviews and Pilot Workshops were used to canvass the collective knowledge and experience of individuals, special interest and various other groups. These included community groups and government and non-government organisations with an interest in the experiences and needs of people with disabilities and in building accessibility and safety (including for specific occupancy/user groups). Participants included, but were not limited to,

- Regulators/enforcers and policymakers (including central and local government),
- Service providers (e.g., health, disability and age care professionals),
- Special interest groups such as the disabled and senior citizens, and
- Universal design specialists.

The interviews and Pilot Workshops were designed to canvas individual experiences, knowledge and ideas to contribute to the following:

- Identify data/measures currently used to describe relevant population sectors/groups (i.e., those with permanent or temporary sensory, physical or cognitive impairments).
- Identify the availability of this data for inclusion in post-workshop analysis.
- Collect information as a basis for:
    i. Mapping building occupant/user capabilities, needs, self-rescue capabilities and expectations and institutional rescue capabilities and expectations, and

ii. Potentially informing performance-based design.

- Identify preferred building design safety features and evacuation plan approaches identified in Phases 1 and 2.
- Identify gaps in data and other information characterising targeted building occupants/users and specification of information and the need for alternative solutions.

The small number of Pilot Workshops (six in total) included participants from a wide range of interest groups in a small number of locations within New Zealand. Initially 23 semi-structured interviews were conducted with individuals from a range of central and local government agencies, community and other special interest groups and buildings and other professionals. These were conducted prior to the Pilot Workshops to both collect information and gauge interest and encourage participation in the Pilot Workshop series. A summary of the location of the workshops and general descriptions of the participants is provided in Table 3.

Table 3: Summary of Pilot Workshop locations and general descriptions of participants.

Pilot Workshop Number	Location	General Description of Participants
1	Christchurch	The workshop included nine individuals representing the following as well as two researchers concerned with the needs of people with dementia: • mobility/physical, post-polio • intellectual disability • deaf and blind impairments • physical disability • mental health • general disability and arthritis • Maori and whanau disability issues • older persons disability issues • Canterbury District Health Board Health in All Policies Advisor
2	Kapiti	The workshop included 15 participants representing the following: • 3 people from Age Concern, two from the local area and the policy manager from the national office • Older Persons Council • 2 people from the Kapiti Accessibility Advisory Group • 3 people from the Kapiti Coast District Council – Acting Social Wellbeing Manager, Building Officer and Eco Advisor • Manager, Coast Access Radio • Facilities Manager, Coastlands Shopping Town • 2 people representing disability concerns in the Kapiti area • 2 people from The Hearing Company, which provides equipment to people with physical and sensory disabilities
3	Paekakariki	The workshop, held in the play centre, included 13 participants including: • ten mothers • one father • two grandmothers

4	Christchurch	Similar to Workshop 1
5	Wellington	New Zealand Fire Service personnel, some of whom were called away to attend emergency incidents
6	Tauranga	The workshop included 13 participants, representing the following (two interpreters for the deaf participant also attended): • Bayfair Mall • New Zealand Blind Foundation • Deaf Aotearoa • New Zealand Fire Service • Age Concern • Accident Compensation Corporation (ACC) • Disability Advisory Group • Barrier Free New Zealand • Safe City Co-ordinator • 2 from Tauranga City Council; a Building Inspector and Community Development Partner • Tauranga District Health Board • Elders Forum
Interviews	Various	23 individuals from a range of central and local government agencies, community and other special interest groups and buildings and other professionals

2.1.2.1 Initial Interviews Format

The initial interviews were structured around asking research participants four key questions:

1. What data sources could be used to directly or indirectly describe the characteristics of the wide range of groups with permanent or temporary disabilities? Are these available to BRANZ?
2. What safety strategies do they use personally when visiting different types of buildings?
3. What current problems, in relation to safe egress for particular groups with disabilities, do they perceive?
4. To address these problems, what feasible (effective, practical, appropriate) fire safety solutions would they suggest?

2.1.2.2 Pilot Workshops Format

Pilot workshops were focused around two potential scenarios:

1. Activation of the building alarm system while in the Pilot Workshop venue.
2. Activation of the building alarm system while in the local mall.

Discussion was facilitated to explore participants' responses to and thoughts about the following:

- Initial reaction to an alarm.
- Initial actions after deciding to respond to the alarm:
    - Prompts that produce actions to be taken.
- Routes sought.
    - Factors taken into account when selecting a route.

- Seeking of assistance.

Where possible, the focus of the workshops was facilitation of participant discussion of building features they identified (rather than prompting to encourage them to talk about specific building features). An example of the Pilot Workshop formats is included in Appendix C.1.

The discussion focused on imagined scenarios, including evacuation of the room in which the Pilot Workshop was being held and a local mall that the individual participants were familiar with. The results reported reflect discussions of previous experience, rather than hypothetical situations.

2.1.2.3 Data Collection

The method for collection, collation and analysis of interview and workshop data and information was chosen to maintain research participant anonymity. This was achieved by:

1. Collection of workshop notes taken by dedicated notetakers attending the Pilot Workshop. Comments were not attributed to identified individual participants,
2. Summarisation of notes by the Pilot Workshop facilitator after the completion of the workshop, and
3. Analysis of the collated notes by a third party (the research leader) who did not attend the workshops. This separation of data collection and analysis further ensures participant anonymity.

2.1.2.4 Intended Outcomes from Pilot Workshops

The interview and Pilot Workshop designs were intended to collect participant-generated data and solutions that may be informed by:

- Participant experiences of problems and practical solutions relating to building egress,
- Their adaptation to and/or interpretation of measures currently present in buildings, and
- Their awareness of and access to relevant data that may be collected by other organisations/sectors/groups (e.g., accident data, health care, insurance, etc.) that may be used to formulate a snapshot of the characteristics of the community.

The research process also included some reflection on the part of the researchers and the participants on the usefulness of the workshop format as:

- A data and information collection tool, and
- A tool to raise participant and other awareness of relevant safe egress issues.

These reflections inform recommendations relating to future workshop programmes.

2.1.3 Post-Workshop Analysis

Post-workshop analysis and summary of workshop results were performed to:

- Map building occupant/user capabilities, needs, self-rescue capabilities and expectations as well as institutional rescue capabilities and expectations,
- Identify preferred building design options and evacuation plan approaches and make recommendations for optimum potential solutions,
- Identify data gaps, and
- Identify potential solutions.

2.1.3.1 Mapping Framework

The framework used for mapping the participant indicated expectations is presented in Table 4. This framework was initially based on the New Zealand and selected international codes and standards requirements and guidance related to egressibility. It was further expanded to accommodate additional concepts emerging from the collated workshop and interview results. The framework is structured around three levels: general egressibility-related building features (e.g., alarms); examples of features (e.g., visual alarms); and any more detailed descriptions of elements of these components. The category of 'Not a Building Feature' was used to capture concepts raised by participants not covered by the current Building Code and standards but related to a feature or function.

Table 4: Summary of the framework used for mapping of egressibility-related Building Code requirements and guidance and collated workshop and interview results.

Building Features	Example Components of Features	Descriptions of Elements of Components
Alarm	Sounder	
	Visual	
	Shaker	
	Pre-recorded voice notification	
	Live voice notification (i.e., using a PA system)	
	NOT A BUILDING FEATURE	
Wayfinding	Emergency lighting	
	Signage – exits, directions, schematic floor schemes	General
		Colours and patterns
		Words
		Symbols
		Tactile signs
		Tactile maps & floor plans
		Reflective
		Backlit
		Photo luminescent
		Tactile walking surface
		Identification of doors
	Trained staff tasks	General
		e.g., inform, usher, guide, direct others to assist or assign 'buddy systems', assist, etc.
	NOT A BUILDING FEATURE	
Egress routes	General	
	Corridor/aisle clearances	
	Surface continuity	General
		Surface smoothness
		Maximum vertical distance of level change to be considered the same level
		Minimum vertical distance of a level change to prevent tripping hazards, etc.
	Doors	
	Door clearances	

	Door operation	Manual, lever, button call, closer operation
	Door opening force	
	Door swing	
	Door swing clearances	
	Ramp specifications (forming part of an exit)	
	Stair specifications (forming part of an exit)	
	Elevator specifications (forming part of an exit)	
	Platform lift specification (forming part of an exit)	
	Escalators and travellators (forming part of an exit)	
	Trained staff (direct others to assist, assist)	
	Assistance devices	General
		Stair assistance device (e.g., evacuation chair, rescue chair, stair sled, staircase stair, stair stretcher, flat/pole stretcher, soft/frameless stretcher, etc.)
	Main access into the building	
	NOT A BUILDING FEATURE	
Stay in place/wait for assistance	General	
	Areas of refuge	
	Exterior area for assisted rescue	
	Signage for areas of refuge	
	Protected floor space	
	2-way voice communication systems	
	Evacuation equipment	
	Rescue provisions	
Evacuation scheme/fire safety plan	General	
	Listing of evacuation equipment, if provided	
	Evacuation training programme	
Definitions	Persons with a disability	
	Human abilities and associated design considerations	

3. RESULTS AND ANALYSIS

3.1 Mapping Results

The collated Pilot Workshop notes were mapped using the framework presented in Table 4 above – that is, against the expanded list of potential egressibility-related building features listed. A summary of egressibility-related code, standard and guidance requirements that were raised by participants is presented in Table 5. Items that were raised are indicated with a tick (✓). Possible features that were not mentioned are indicated with a circle (o). More detail about research participants' shared experience of and attitudes about this range of building features is provided in Section 3.1.1.

Table 5: A summary of egressibility-related code, standard and guidance requirements that were raised by participants.

Building Features	Example Components of Features	Descriptions of Elements of Components	Pilot Workshop Responses		
			Positive Response	Negative Response	Suggested Solutions
Alarm	General		✓	✓	✓
	Sounder		✓	✓	✓
	Visual		✓	o	o
	Shaker		o	o	o
	Pre-recorded voice notification		✓	o	o
	Live voice notification (i.e., using a PA system)		✓	✓	o
	NOT A BUILDING FEATURE		✓	✓	✓
Wayfinding	General		✓	✓	✓
	Emergency lighting		o	o	✓
	Signage – exits, directions, schematic floor schemes	General	✓	✓	✓
		Colours and patterns	✓	o	o
		Words	o	✓	o
		Symbols	✓	o	✓
		Tactile signs	o	o	o
		Tactile maps & floor plans	o	o	o
		Reflective	o	o	o
		Backlit	o	o	o
		Photoluminescent	o	o	o
		Tactile walking surface	o	o	o
		Identification of doors	o	o	o
	Trained staff tasks		✓	o	✓
		e.g., inform, usher, guide, direct others to assist or assign ‘buddy systems’, assist, etc.	✓	o	✓
	NOT A BUILDING FEATURE		✓	✓	✓
Egress routes	General		✓	✓	✓
	Corridor/aisle clearances		o	o	o
	Surface continuity		o	o	o
		Surface smoothness	o	o	o
		Maximum vertical distance of level change to be considered the same level	o	o	o

		Minimum vertical distance of a level change to prevent tripping hazards, etc.	o	o	o
	Doors		✓	✓	✓
	Door clearances		o	o	o
	Door operation	Manual, lever, button call, closer operation	o	o	o
	Door opening force		o	o	o
	Door swing		o	o	o
	Door swing clearances		o	o	o
	Ramp specifications (forming part of an exit)		✓	o	v
	Stair specifications (forming part of an exit)		o	o	✓
	Elevator specifications (forming part of an exit)		✓	✓	✓
	Platform lift specification (forming part of an exit)		o	✓	o
	Escalators and travellators (forming part of an exit)		o	o	o
	Trained staff (direct others to assist, assist)		✓	✓	✓
	Assistance devices		✓	o	o
		Stair assistance devices	✓	o	✓
	Main access into the building		✓	✓	✓
	NOT A BUILDING FEATURE		✓	✓	o
Stay in place/wait for assistance	General		o	✓	o
	Areas of refuge		✓	o	✓
	Exterior area for assisted rescue		o	o	o
	Signage for areas of refuge		o	o	o
	Protected floor space		o	o	o
	2-way voice communication systems		o	o	o
	Evacuation equipment		o	o	o
	Rescue provisions		o	o	o
Evacuation scheme/fire safety plan	General		✓	o	✓
	Listing of evacuation equipment, if provided		✓	o	o
	Evacuation training programme		✓	✓	✓
Definitions	Persons with a disability		o	o	o
	Human abilities and associated design considerations		o	o	o
Fire control systems	Sprinklers		o	✓	o
Public education			✓	o	✓
General			o	o	✓

A comparison of the New Zealand features raised by Workshop and interview participants and the features with code, standard requirements or guidance indicates some areas where there is a lack of overlap. A summary of this comparison is presented in Table 6. The shaded cells indicate areas where discussion was raised by participants but there is currently a lack of egressibility-related features in the New Zealand context.

Table 6: A summary of egressibility-related code, standard and guidance requirements that were raised by participants and features with related requirements or guidance.

Building Features	Example Components of Features	Descriptions of Elements of Components	Pilot Workshop Responses			Selected International Sources	New Zealand Sources
			Positive Response	Negative Response	Suggested Solutions		
Alarm	General		✓	✓	✓	✓	✓
	Sounder		✓	✓	✓	✓	✓
	Visual		✓	o	o	✓	✓
	Shaker		o	o	o	✓	o
	Pre-recorded voice notification		✓	o	o	✓	o
	Live voice notification (i.e., using a PA system)		✓	✓	o	o	o
	NOT A BUILDING FEATURE		✓	✓	✓	o	o
Wayfinding	General		✓	✓	✓	✓	✓
	Emergency lighting		o	o	✓	✓	✓
	Signage – exits, directions, schematic floor schemes	General	✓	✓	✓	✓	o
		Colours and patterns	✓	o	o	✓	o
		Words	o	✓	o	✓	o
		Symbols	✓	o	✓	✓	o
		Tactile signs	o	o	o	✓	o
		Tactile maps & floor plans	o	o	o	✓	o
		Reflective	o	o	o	✓	o
		Backlit	o	o	o	✓	o
		Photoluminescent	o	o	o	✓	o
		Tactile walking surface	o	o	o	✓	o
		Identification of doors	o	o	o	✓	o
	Trained staff tasks	General	✓	o	✓	✓	o
		e.g., inform, usher, guide, direct others to assist or assign ‘buddy systems’, assist, etc.	✓	o	✓	✓	o
	NOT A BUILDING FEATURE		✓	✓	✓	✓	o
Egress routes	General		✓	✓	✓	✓	o

	Corridor/aisle clearances		o	o	o	✓	o
	Surface continuity		✓	o	✓	✓	✓
	Doors	General	✓	✓	✓	o	o
	Door clearances		o	o	o	✓	o
	Door operation	Manual, lever, button call, closer operation	o	o	o	✓	o
	Door opening force		o	o	o	✓	✓
	Door swing		o	o	o	✓	o
	Door swing clearances		o	o	o	✓	o
	Ramp specifications (forming part of an exit)		✓	o	o	✓	o
	Stair specifications (forming part of an exit)		o	o	✓	✓	✓
	Elevator specifications (forming part of an exit)		✓	✓	✓	✓	o
	Platform lift specification (forming part of an exit)		o	✓	o	✓	o
	Escalators and travellators (forming part of an exit)		o	o	o	✓	o
	Trained staff (direct others to assist, assist)		✓	✓	✓	o	o
	Assistance devices	General	✓	o	o	✓	✓
		Stair assistance devices	✓	o	✓	✓	o
	Main access into the building		✓	✓	✓	✓	o
	NOT A BUILDING FEATURE		✓	✓	o	o	o
Stay in place/wait for assistance	General		o	✓	o	✓	✓
	Areas of refuge		✓	o	✓	✓	✓
	Exterior area for assisted rescue		o	o	o	✓	o
	Signage for areas of refuge		o	✓	o	✓	o
	Protected floor space		o	o	o	o	o
	2-way voice communication systems		o	o	o	✓	o
	Evacuation equipment		o	o	o	✓	✓
	Rescue provisions		o	o	o	✓	✓
Evacuation scheme/fire safety plan	General		✓	o	✓	✓	✓
	Listing of evacuation equipment, if provided		✓	o	o	o	✓
	Evacuation training programme		✓	✓	✓	✓	✓
Definitions	Persons with a disability		o	o	o	✓	✓
	Human abilities and associated design considerations		o	o	o	✓	o
Fire control systems	Sprinklers		o	✓	o	-	-
Public education			✓	o	✓	✓	o
General			o	o	✓	-	-

3.1.1 Summary Relative to Egressibility-Related Features

The following section provides a summary of interview and workshop participants' responses and discussions about a selection of building features used in the mapping analysis (see Table 6). This summary also includes their suggestions about how the current New Zealand context may be improved. The wide range of features they raised include:

- Alarms,
- Wayfinding,
- The role of wardens
- Exit routes,
- Use of elevators and ramps,
- Use of assistance devices (e.g., evacuation chairs),
- The place and value of areas of refuge,
- The content of evacuation schemes/fire safety plans, and
- Sprinkler systems.

They also discussed general themes such as the impact of their familiarity or unfamiliarity with a building on their safe egress. The impact of people's awareness and perception of risk on their behaviours and expectations was also raised. Finally, they emphasised the importance of public education.

3.1.1.1 Alarms

Research participants, in general, indicated that they would take an alarm seriously, regardless of any suspicions they may have that it might be a drill or a false alarm. This seriousness is a reflection of their potentially impaired ability to exit safely and quickly in the event of a real emergency and, therefore, their need to respond to an alarm immediately. The range of summarised comments below provide further elaboration of how their various impairments may affect their egress capability. Some participants pointed out the difficulties they may have sensing an alarm.

Several workshop participants indicated that they would start moving on the sound of an alarm – that they never assume is it a drill and always take an alarm seriously.

Some mentioned that they would observe how others are reacting or look to security staff's guidance.

One participant noted that her attitude toward an emergency has changed as a consequence of the 2010 and 2011 earthquakes in Christchurch. Her heightened risk perception means she would take any alarm seriously.

A blind participant, attending with his seeing-eye dog, would take an alarm seriously because he has no choice considering his physical ability.

A participant with a hearing disability pointed out that she would have more difficulty knowing something was going on, especially if she was away from others (e.g., in a toilet). As she said: "My family members are also all deaf. No one would know what is going on." Otherwise she would 'go with' the body language and other reactions of people around her and would follow them. She also noted that it should be required that alarms 'flash'.

Another hearing impaired participant indicated she would expect to see flashing lights to indicate an emergency.

Some participants had to seek advice about alarms in the workshop venues. A deaf participant asked whether it flashes in an emergency. As she noted, she would "need a flashing light to alert her". A blind participant said he would need some verbal guidance (e.g., a voice alarm activating and telling him to "evacuate now").

Several participants with physical disabilities said they would be slow to move after an alarm, so would initially stand back until others had moved.

One participant indicated that their familiarity and comfort with the building would change/influence their action or response.

3.1.1.1.1 Alarm – Notification Systems

A number of research participants indicated that they would want supplementary information as soon as possible after an alarm occurred. They would like information, for instance, about what an alarm may be indicating and what they should do.

Some participants would want information about what is going on and where to go.

Some participants would wait for a voice announcement to confirm the alarm and directions for the next steps of action.

Some indicated they would listen for an emergency announcement. They expected that this would likely happen in a public building.

One participant talked about visiting the Dunedin Stadium. The sound of the air being blown into the roofed complex alarmed people visiting from Christchurch as it had sounded like the rumble of an earthquake. She suggested that a better information system could have reassured them.

3.1.1.1.2 Alarm – Not a Building Feature

As described above, most research participants would take an alarm seriously and immediately prepare to take appropriate action. Identified preparations include:

- Collecting together and packing up all their stuff (maybe pushchairs, bags).
- Getting children or other dependents ready to move, e.g., unstrapping a child from high chair, and 'grabbing' toddlers. As one parent said, it would depend on the age of his children what he would do (carrying them, pushing the pram, having them walk, etc.).
- Answering children's questions about what is going on.
- Looking for the exit.
- Searching around for signs of what is going on.
- A blind participant said he would prepare his dog for leaving (and his dog would be very alert to the danger), so that the dog would lead him out. If he did not have his dog, he would prepare by asking for help from someone nearby.
- Some able-bodied participants would look for others who would need help to exit.

Some participants, especially those with physical impairments, would wait until others had moved so as not to be an obstacle to them.

3.1.1.2 Wayfinding

A major concern for participants is how they would identify the nearest, safest (e.g., obstacle-free) and quickest way out of an emergency situation. This concern becomes increased if they were in an unfamiliar place or a complex environment like a shopping mall. Those who anticipated being unable to self-evacuate wondered how they would know where a place to wait might be and how they might get to it. They talked about the

need for (but also the problems with) universal signage, locating exits and their possible distinction from entries. They also talked about locating alternative exit routes should the configuration of a building change or known exit routes become impassable and whether exits are necessarily passable.

Most participants said their first priority after an alarm would be identifying exit routes, especially if they are different from the entry routes.

Most would rely on signage. Some, however, pointed out that exit signs can be hard to see in malls and other large buildings when there are high ceilings. A couple of participants suggested arrows that light the way to nearest exits, like on a plane and another suggested illuminated floor signage. Another suggested that buildings need to include mechanisms to draw people's attention to exits, as do emergency drills or presentations in planes. But another said that exit signage is common sense once you first figure it out.

Universal signage was indicated to be important. A discussion of the emergency exit sign indicated some problems for people with sensory disabilities as well as for others unfamiliar with the meaning of the sign. As one participant noted, not all people would recognise that the 'running man' sign, in the absence of any wording, indicates an emergency exit. Some recommended public education on the symbol of the running man because it is not seen to be 'common knowledge'.

Participants who did not recognise the green running man symbol indicated that they expected to see the 'exit' word associated with the symbol for clarification. They also acknowledged the value of a symbol which could be universally recognised (e.g., by visitors from overseas).

The colours of emergency exit signage need to contrast well to aid people with sight impairments. Colour examples identified as good include green and white. Another agreed, laughingly saying that green is a good sign. Others also worried about the resilience of the sign if power was lost as a consequence of the fire as the sign may not flash any more. Some, therefore, would prefer the sign to be static.

Some pointed out that, prior to the workshops, locating emergency exits in a mall has not been a priority. Ironically, one parent noted that checking the location of toilets is a priority if he has his children with him.

One participant noted the importance of finding exit routes in places where the building's configuration could change during a fire event. For instance in one downtown complex in Wellington, large screens come down (to contain the smoke). These block off the escalator and atrium area, thus blocking off the main entrance and exit routes and doors. As he noted, people would need to locate and then use an alternative emergency exit route if there is a fire.

If staying overnight with young children, one participant indicated he would walk the exit route with them so that they could find their way in the dark (or smoke) in the event of a fire. This strategy was considered important as sleepy children need to be ready to find their way out in the dark. They would talk the route through with older children.

One participant suggested that government buildings should set the standard – and should be retrofitted to meet the requirements of the current code regardless of the age of the buildings. He and others want consistency of fire safety features irrespective of building ages. Others agreed and one described the absurdity of different standards across buildings of different ages (e.g., 1995 buildings versus 2015 buildings) when similar activities occur in the buildings. They suggested mandatory safety requirements regardless of the age of the building.

One participant suggested that in some buildings it is difficult to find emergency equipment (e.g., hose reels, egress signs and routes) because they are integrated into

the decor. These buildings have met minimum standards for fire safety but the signage and the equipment are hard to locate.

And some participants felt that locating exit routes was insufficient on its own. They worry about whether exits are actually 'openable'.

3.1.1.3 Wardens/Assistance

Wardens and other assistants (both designated and from amongst other building users/occupiers) would play an important role in safe egress for most research participants. Some would need physical help to egress or get to a place of relative safety, some would need reassurance (e.g., those with dementia) and most would want advice and/or information.

Around one in three participants in workshops indicated that they would need assistance to egress in an emergency. Others stressed the need for people to be as self-reliant as possible (for instance, some expressed concern that people in general are becoming less and less self-reliant). As some participants pointed out, though, self-reliance is only possible if buildings are designed and equipped so that people with disabilities can help themselves. One participant suggested that building visitors should locate and read the building emergency plan (where the exits are, where to go) first. This leads to work out a personal plan of where to go in an emergency (and the location of the fire extinguisher and other equipment).

Whether people ask for the assistance they need or not is possibly an issue. Some participants indicated that they would not want to be a nuisance, so may not ask for help but would wait for it to arrive. Others indicated that they would be proactive and ask or just take an arm of a nearby person or seek out a warden. Participants suggested that people with dementia may not know or look like they need help. Wardens need training and education about how to respond to their stress and anxiety and provide reassurance.

Participants talked about New Zealand being a safety-conscious country. We are trained to think about others in an emergency situation, where they are and what needs to happen to ensure that everyone is safe. Some suggested that New Zealanders are generally very altruistic. For instance, several participants indicated that they would assist others unless, for instance, they were needed to assist family members.

The importance of well-trained wardens was raised by a number of participants. Some firefighting professionals noted that wardens need to have a clear understanding of the evacuation scheme of their building and focus on evacuating people first. They also need to provide clear information for the arriving Fire Service.

Some participants suggested that wardens need consistent training and, to that end, training standards are needed to guide the training offered by a range of private providers (e.g., building owners/managers, etc.). For instance, mall managers involved in workshops pointed out that many retail staff would take on warden responsibilities in an emergency and would be there to provide leadership and guidance. In other workshops, participants said they would expect the workshop organiser or facilitator to both provide safety information at the beginning of a meeting and provide leadership during an emergency.

The training is needed to show/stress the importance of the role, for instance to clear floors, record information on the fire panel and know who will communicate with the Fire Service (to avoid both duplication and omission). Wardens need to take the job seriously; the greatest issue is their ability to follow their own procedures. A good warden training system would also speed up the time before the Fire Service can 'give the building back to the warden' who in turn allows occupiers back in.

3.1.1.4 Exit Routes

As discussed in Section 3.1.1.2, research participants were very concerned about how they would know where to go in an emergency. Their concerns related to both identifying exit routes, especially if they were different from the entry route(s), and the accessibility of those routes. As some pointed out, finding the exits would be their first priority.

Some participants referred to the importance of (and difficulties with) finding exit routes in places where the building's configuration could change during a fire event. As discussed previously, the activation of smoke curtains (smoke screens, fire shutters and similar acting devices) can change exit routes and make the layout of a building newly unfamiliar.

Some participants indicated that they would try to leave a building the same way they came in.

Some indicated their choice would depend on the possible speed of their exit. That, rather than the way they arrived, would be their prime consideration. So, they would go out the nearest exit or the most direct route to the outside.

Some would be looking for the most accessible exit, even if it was further to go than the shortest route.

Some would be looking for a safe arrival place (e.g., free of traffic, crowds and, of course, the source of the emergency). One participant with physical impairments said she would take the quietest route. Factors participants would be taking into account would include:

- Obstacles to safely getting to the exit and beyond;
- What others may do or where they might go that could create obstacles;
- Whether they would create an obstacle themselves (they stress the need for stairs wide enough for people with disabilities to wait without blocking the movement of others); and
- Where they were in relation to exit options.

Another consideration for some in evaluating exit routes would be their ability to open doors and, for some, concerns about whether door would be operational should there be a power outage.

Some indicated they would be looking for ramps and other provisions that enable disabled people to be self-reliant and to self-rescue where possible. As they said, it was not enough to encourage self-preservation, it also needs to be made possible.

One participant indicated that in a crowded situation (like a stadium) they would wait to see what others do or wait to be rescued especially if they could not use the elevator.

A participant with a sight impairment indicated that he has a map in his head about how to get into a building because he travelled it to get here. However, in an emergency, "I don't have a similar map about where to go".

3.1.1.5 Elevators

Participants in most workshops spent time discussing the use of elevators. Most assumed they would not be able to leave their current location in the building the way they had come in if they arrived via an elevator. By the way, this was generally the case for people with disabilities coming to a workshop held anywhere but the ground floor. They assumed that elevators would be out of bounds or out of action during an emergency event. Though participants generally could not identify signage indicating such a ban, they suggested it was common knowledge. Some noted that there are often signs in buildings telling people not to use them during an emergency. One or two also

pointed out that using elevators could be dangerous anyway, because they may cease operating and leave their users stranded or could take users to a dangerous place.

Most indicated they would not use an elevator, but might if a firefighter or someone else in authority was in the elevator or gave them permission. Some noted that they would use elevators if firefighters said they could, but not without additional guidance because, as one person said, she had been told it could be very dangerous.

Others noted the problems any non-availability of elevators would create for them. In some cases, they believed it was their only way to access or egress a building.

3.1.1.6 Ramps

The availability of well-designed ramps was highly valued by people in wheelchairs. For instance, a participant helping his wheelchair-bound family member indicated that one of the important features he looked for when considering a building's fire safety was accessible ramps.

Ramps were a commonly-identified access/egress feature by participants (e.g., ramps were more commonly mentioned than evacuation chairs, elevators, etc.).

3.1.1.7 Assistance Devices

Research participants varied in their views about the value of assistance devices like evacuation chairs. In general, though, they supported measures that enable people to self-evacuate where possible or get to a place of refuge. Most of the workshop discussion around evacuation chairs focused on protocols around their use, by both those with disabilities and their assistants. Research participants stressed:

- The need for chairs on each level of a building if they were to be installed,
- The need for alternative wheelchairs or other suitable mobility devices for users when they arrived at the final destination, and
- The need to build users' and helpers'/operators' familiarity with the devices before an emergency arises.

When/if evacuation chairs are installed, thought needs to be given to what happens to the users when they reach their destinations (without their usual personal mobility devices). There would need to be another wheelchair or other suitable mobility equipment at the end of the evacuation chair journey.

People who are likely to need or help operate evacuation chairs need practice/training for their use. Emergency situations are fraught and people unfamiliar with the mechanisms could panic (both users and assistants). For example, one participant described her body becoming rigid during a drill so that she could not bend to sit in the evacuation chair. She anticipates that her reaction could be even worse in an emergency. She would like to be able to practice using the chair with an assistant outside of emergency situations to build up their familiarity and confidence with the device. If she was familiar with its operation and comfortable with using it in a non-emergency condition, she may be more ready and able to use it in an emergency. Christchurch workshop participants suggested that pre-emergency practice could be organised along the lines of a recent campaign to encourage bus use. For example, a 'have-a-go-evac-chair day' could potentially mirror the successful 'have-a-go-bus-day' campaign.

Opportunities to become familiar with equipment are seriously curtailed when people who would need special assistance to exit during an emergency are not included in practice drill exercises. Participants' experience is that this exclusion is not uncommon.

One participant with arthritis indicated she would reluctantly use an evacuation chair if necessary. However, as long as there is a handrail in the stairway and only a few levels

to descend she would prefer to exit via stairs independently. She wondered whether the chair would be speedy enough to improve on her own egress time.

One participant in a wheelchair had several comments about evacuation chairs. They can be scary, can give a bumpy ride and may hurt. They tend to be designed with an average one-fit-does-all approach. She is small so bits of the mechanism press in at the wrong places and hurt. She stresses that the chairs need to accommodate people of different sizes and need to be padded to be useful.

Devices like evacuation chairs can aid people's self-evacuation, thereby potentially freeing Fire Service's resources so that they can be fully devoted to putting the fire out. It takes one engine (two firefighters) to assist one person out of a building.

3.1.1.8 Areas of Refuge

There are two principle reasons why people in the workshops anticipated needing to go somewhere like a place of refuge (not that many used such a term and some confused it with a safe place). They would go there to wait for assistance (especially those with mobility aids such as wheelchairs) and to get out of the way of others trying to leave. The latter reason, to avoid becoming an obstacle to others, was important to participants. They tended to assume that such places would be in the stairwell of a building (ideally enough room for them to wait and not block others) or in the elevator area. However, no one could cite signage they had seen to identify such a place and most would not know where to go in a shopping complex like a mall. They would have to wait for or seek advice. The following outlines some participant views and experiences.

Several participants in wheelchairs talked about their intention to get out of the way of others in the event of an emergency. One talked about his experiences of fire drills while working in multi-storeyed buildings in Wellington. He said his wheelchair would create danger for others trying to get out. He described one experience when he was on the sixth floor of a building in Wellington and was moved to a stairwell to wait for the Fire Service to rescue him.

Two participants with physical disabilities indicated that, in the event of an emergency in the workshop venue, they would wait for others to leave the room and then go to the stairwell.

One said she would wait in the room for a firefighter to collect her and take her downstairs.

Participants indicated that people generally do not know where these areas are and there is generally a lack of information/communication about their location.

One with a sight impairment noted that he would not need to know where the area was because he would be escorted by others.

Another stated that the place of refuge would be his second choice as the first choice would be the emergency exit.

Another said she would wait near the lift expecting help from firefighters coming up.

Another indicated that she would need more technical advice from trustworthy people before heading for such a place. She would like reassurance (and an explanation about why/how) it is a safe place.

Another talked about a need to be aware of cultural issues in thinking about areas of refuge and people's ability to locate them. Some people may have communication problems (English as a second language, hearing loss, etc.) and some may be too shy to ask or be reluctant to be a nuisance.

To address people's general lack of knowledge about areas of refuge, there needs to be more information about these areas and their location readily available and widely accessible.

3.1.1.9 Evacuation Schemes/Fire Safety Plans

Workshop participants' views and experiences provide the basis for developing some rules of thumb for designing evacuation schemes and safety plans. These rules of thumb reiterate messages also contained in other sections (e.g., who might need assistance, etc.). These rules of thumb include the following.

Assistance to exit a building in an emergency or go to a place of refuge is likely to be needed for:

- Wheelchair users;
- People with vision impairments (especially if they are alone or have the responsibility for others);
- Those caring for disabled relatives or others; and
- People showing anxiety (e.g., someone with dementia).

One woman's recent experience illustrates the unpredictability of people behaviour, especially if they have some cognitive impairment. Her husband has had a stroke and his new stubbornness might mean he would refuse to exit a building in an emergency. She was alerted to such a possibility in a recent, dangerous scrub fire incident on the outskirts of Christchurch during which he refused to leave their home. On that occasion, it was only because her daughter was visiting that they could together get him out of danger.

The types of assistance people anticipated needing included:

- Information about where to go;
- Calming words – especially for people with dementia;
- Physical help for people with physical disability;
- Patience, e.g., some individuals move quite slowly and the feeling of being rushed is counterproductive;
- Understanding of the limitations of some individuals; and
- Confidence in the person offering assistance.

Good communication and training is the key to the provision of appropriate assistance for the range of building occupants to the Fire Service responding to the incident.

Public education, including ongoing repetition of key messages, is also needed to ensure people take the risk of fire seriously and plan and respond appropriately.

Education about evacuation schemes so that people know what is intended to happen in a real emergency event. Their experiences of evacuation drills may leave them with some misconceptions or incomplete understanding. For instance, participants' experiences suggest that people might expect to be able to access their cars in a mall-based emergency because they have been allowed to do so in previous drills. In addition, people may not know what will happen when they have been excluded from practice drills or have gone through an incomplete process. For instance, someone in a wheelchair may be taken to an area of refuge during a practice drill but not know what would happen next because they were not taken to the next stage, i.e., a safe place.

Inclusion of assessment of accessibility and egressibility in a warrant of fitness for a building was suggested.

3.1.1.10 Sprinkler Systems

A few research participants talked about sprinkler systems, especially with reference to obstacles for people with mobility or cognitive impairments. They shared a misperception that a sprinkler system would activate throughout a building and wet everything in a fire emergency, thus creating slippery floors. Despite this misperception, a sprinkler system was still seen as a positive safety feature.

3.1.1.11 General

Research participants did not limit their discussion to individual building features when they considered factors important to their safety in an emergency event. They took a more holistic view, emphasising the need for building designers to take an integrated approach that put safety first. They made the point that specifically designing to ensure the safety of people with disabilities ensures the safety of everybody. Also, in the absence of such a focus, a building's accessibility is seriously compromised. As one participant pointed out: “If you don’t plan us in, you plan us out.” And as another participant stated: “Everybody is temporarily able-bodied.” This highlights that we will all make use of accessible/egressible features of the built environment at some points in each of our lives, whether temporarily or on a longer term basis.

It was suggested that having accessible entry and exit provisions that encourage everyone to use and enjoy the built environment would make buildings more economically viable in the medium and long term. For instance, good design would attract more people with disabilities and people with disabilities usually bring other people as well: which is good for business. It was suggested that econometric studies of the costs and benefits of integrated design is needed.

Other factors potentially affecting building users' safety included their familiarity with the building, their awareness and perception of risk, and the information available to them about key safety features through public education.

3.1.1.11.1 General – Occupant Familiarity of Building

In general, research participants were more concerned about safe egress in a building they were not familiar with. In the scenarios based around the workshop venues most participants were confident about what they would do and where they would go because, in many cases, they had visited the venue before. For instance, in one workshop on the second level of a large building, a participant in a motorised wheelchair was confident that she could safely egress without assistance. It was because she knew the emergency exit door led straight to a ramp that took her to a safe place outside of the building.

Participants were generally less confident about egressing from a mall complex without assistance. It was partly because they were less familiar with its layout (especially in multi-level malls) and the location of emergency exit options – and where they would end up. Other factors also come into play though, particularly crowding and the possibility of blocked routes.

Some participants described strategies they had developed to familiarise themselves with buildings they may be visiting, especially if they are staying overnight. For instance, one talked about always taking his young children for a walk through the exit route of a hotel if they were staying overnight. This would enable them to be more prepared to find their way out in the dark. Another regular traveller talked about always checking the emergency exit routes in hotels he stayed in around the world. And a sight-impaired man realised he needed to develop a strategy. He reported always having a map in his head about how to access a building he was visiting but did not have the equivalent for egressing in an emergency.

3.1.1.11.2 General – Access as a Reflection of Egress

In various Pilot Workshops, participants using mobility devices talked about the convoluted means of access they were required to make into some buildings (e.g., via 'back of house' areas like kitchens, etc.). They were concerned because they expected that such means of access would be the only way out during an evacuation.

3.1.1.11.3 General – Awareness and Perception of Risk

Research participants varied in their awareness and perceptions of risk – to themselves and to others. Some talked about their heightened awareness given their previous experiences (e.g., of drills, of visiting what they saw as risky venues, of earthquakes and aftershocks for Christchurch participants). Some talked about the effects of discussions in the Pilot Workshops. Some talked about their reluctance or refusal to limit their experiences and opportunities, given their physical or sensory disabilities. The steps participants described as taking to ensure their families are safe varied and were sometimes very precautionary. These steps reflected their heightened sensitivity to the risk of fire and the potentially hazardous nature of some buildings or destinations. There were some no-go areas and they took special care when with children or disabled family members. The following are some of their reflections.

A participant in a wheelchair talked about his intention to get out of the way of others given that he might be an obstacle to their safe egress. He talked about his experiences of fire drills while working in multi-storeyed buildings in Wellington where his wheelchair would create danger for others trying to get out.

One participant with bad arthritis talked about her concerns having attended a conference at a large conference centre, given the long travel distance along corridors to the conference room. She believes this is a poor design for people with disability. She also talked about a lack of information and advice about what would happen in an emergency at that venue/event. She would have liked someone to tell her about how/where to exit in such circumstances.

A participant in a wheelchair noted that "life itself is risky". She said that she has not changed her behaviour much and constantly weighs up the risks and her choice of lifestyle (with the latter being a very important consideration).

One man with a sight impairment talked about his four-storey residence with only one exit on the ground floor. Bedrooms are on the top level and he indicated that he is now more aware of that as a hazard following participation in the Pilot Workshops. Subsequently, as part of earthquake repairs, he is having a home sprinkler system installed.

One participant queried if it is up to the occupants of buildings to assess the risk or that responsibility sit with the building owner or tenant. Other participants in the workshop said they believe it is a shared responsibility.

3.1.1.12 Public Education

Participants talked about the need to raise awareness of disability issues. This is so that the public recognises and advocates for a more disability-friendly built environment. It is also so that the building sector, including designers, developers and regulators, better understands the need for and value of universal design features. One example of programmes raising awareness about disability issues was a local district council initiative to provide such training for staff. Some participants suggested similar training could be usefully provided to other organisations offering goods and services to the wide range of people with disabilities.

Another common theme raised in workshop discussions was the need for public education and the provision of safety information at general and building-specific levels. A discussion in one of the workshops provides a nice illustration. Participants' concerns

about safe egress in a local mall were largely put to rest when the operations manager (a participant in that workshop) described the mall's safety procedures and safety features. This provided new insights for participants who saw it as a generally positive and useful experience. They suggested such information and education leads to reassurance and should be provided within all malls.

And the third education theme centred on self-reliance. Across several workshops, participants talked about what they saw as diminishing self-reliance in society generally. However, discussions amongst participants in different workshops showed them to be a tenacious group. Most of them anticipated being proactive (e.g., actively seeking help or self-evacuating) in an emergency. Nevertheless, they felt that there needs to be some public education campaigns focusing on encouraging self-reliance.

Below is a range of workshop discussions and concerns:

- Participants were concerned that there is a general 'blindness' to disability, with current generations less aware than those in the past. They suggested that there seems to be a gap in education and awareness about disability. Therefore, education and awareness-raising is essential to get widespread societal recognition that the built environment needs to be user-friendly and safe for everybody. They suggested that education about disability issues needs to start in schools. Two participants talked about the value and effectiveness of being introduced to the reality of disability when they were children and the lasting sensitivity to disability issues these experiences gave them.
- Education to encourage self-advocacy/self-reliance is important and needs to start in schools.
- Parents and the community also have a role to play in education about disability and about self-reliance in an emergency.

4. DISCUSSION

4.1 Key Workshop and Interview Themes

4.1.1 Current Situation

Population trends point to increasing disability. Like other developed countries, New Zealand's population is ageing. Statistics New Zealand, based on its latest population projections, anticipates that, along with an ageing population, there will be continuing low fertility, further longevity gains, and an older labour force[4]. The estimated 50 percent share of Government's welfare spend on superannuation is one indicator of the current size of the 65-plus-years population[5]. Some of these projections (e.g., continuing low fertility and longevity gains) indicate a continuation of this ageing of the population. The New Zealand Positive Aging Strategy[6] is one Government response to these population trends.

Part of the ageing process, particularly for the older groups (e.g., those over 80 years) is increasing frailty including physical, sensory and cognitive impairment. For instance, according to the New Zealand Blind Foundation, currently 67 percent of over 65 years and 80 percent of over 80 years have a sight impairment. The Foundation estimates that a larger-than-acknowledged proportion of the population overall has serious sight

[4] http://www.stats.govt.nz/browse_for_stats/population/estimates_and_projections/projections-overview.aspx
[5] Seniors count 2014-2019 http://www.seniorsonline.vic.gov.au/home/services-and-information/your-resources/seniors-count
[6] https://www.msd.govt.nz/what-we-can-do/seniorcitizens/positive-ageing/strategy/

impairments. It estimates that up to 100,000 New Zealanders do not recognise they have a sight impairment.

4.1.1.1 Encouraging Self-Reliance

In emergencies (fire, earthquake, etc.) people need to be as self-reliant as possible, given what their level of disability/ability allows. To enable self-responsibility and self-management in emergency situations, everyone needs to know what to do and to have opportunities to practice (e.g., through drills). Unfortunately more than one disabled person reported that they are often exempt from drills or partake only partially (e.g., go to a place of refuge but do not continue to a safe place). This means their first time of trying to quickly egress from a building or using safety equipment like an evacuation chair may be in a real emergency situation. It may be that New Zealand's safety culture (reflected in legislation, requirements for and nature of drills, etc.) undermines self-reliance. Making a shift to self-reliance needs to start early, for instance through education from school onwards.

4.1.1.2 Accessibility and Egressibility Needs

Everyone has the right to access public buildings. Given that the proportion of people with impairments at any one time will grow as the population ages, a baseline for building design should be to meet the requirements of people with disabilities. If the building works for them (in terms of accessibility, egressibility and use), then it will work for everyone. The design litmus test for a building is whether people in all of their various stages of ability and disability can and will want to use that building over its lifetime.

We cannot measure potential usage by current usage/trends as the provision of more accessible/egressible buildings would encourage more use by a wider range of people, many of whom are currently excluded. Building design needs to be inclusive: a failure to plan for entry and egress of people with disabilities plans them out. The ease with which people with disability can get into a building will shape how easy it is for them to get out in an emergency.

Housing design needs to allow people with disabilities to make choices about how they live. Some research participants suggested that, in New Zealand, because disability service providers are concerned about residential costs, people with disabilities in residential care tend to get pushed into larger complexes. This is often the antithesis of what they want, which is a living environment that mirrors that of the rest of the general population. For housing stock to meet the needs of the future population, residential facilities and their scale needs to mirror and allow the ordinary processes that go on in an ordinary home. So the building stock needs to be designed and/or adapted to meet that need.

Barriers to good design include the belief that safe egress for people with disabilities is relevant to a small number of people only and is costly. New Zealand needs a stronger rights base to ensure people with disabilities are treated on the same basis as the population as a whole.

One or two research participants pondered the feasibility of some accessibility features. They questioned whether it is possible for everyone to have the right to be equally safe in an emergency. They also questioned whether an acceptable balance can be found between what is preferable (assisting everyone to live normal lives) and what is possible (providing an equivalent level of safety). They suggested that the 80/20 principle could help set sensible standards that are linked to self-reliance strategies. Some research participants in wheelchairs wryly remarked that they suspected they would perish should they be caught in a fire in a multi-storey building. One woman in a motorised wheelchair said she accepted some risk to maintain the lifestyle she valued.

4.1.1.3 Legislative Shortcomings (Including Application)

Identification of shortcomings, some of which are listed below, are attributed to factors such as insufficient consultation with key disability interests and insufficient attention in the development of regulations and standards. Identified reasons for these deficiencies include the following:

- Lack of leadership and cross-party or bipartisan approaches to accessibility issues.
- Over reliance on overseas data and codes (often developed in response to tragic events) without understanding the particular historical contexts that prompted their development and application.
- A focus on accessible journeys, without consideration of risks along the way, rather than 'safe accessible journeys'.
- Varying awareness of disability issues by building officers, other local government officers, building-related consultants and others involved in the design and consent process.
- Local government discretion over accessibility requirements, given the absence of prescribed requirements, coupled with varying levels of willingness amongst developers to include adequate accessibility and egressibility features.
- The absence or inadequacy of requirements to improve accessibility when, for instance, a building is upgraded or its use changes. For instance, the new legislation addressing earthquake-prone buildings[7] excludes such requirements.

4.1.2 Indicated Emergency Behaviours

In two scenarios (one in each workshop venue and another in a local mall) workshop participants were asked a series of questions to gauge how they are likely to respond to an alarm being raised (audible and visual). These questions asked:

- What they would first think is going on;
- What is the first thing they would do;
- What would prompt them to move;
- Where they would go and by what route;
- What factors they would think about as they started to move; and
- Whether and from whom they would ask for help.

The following are some general themes that emerged from the ensuing discussion.

4.1.2.1 Initial Reaction to Alarm

Reactions tended to reflect a mix of participants:

- Levels and types of ability/disability (e.g., do they expect to be able get out without help, will their slowness impede others, could they hear/sense the alarm);
- Responsibility for others at the time (e.g., those with children, disabled relatives, etc.); and
- Past experience (e.g., assistance arrived quickly for an older woman with severe arthritis in a previous mall fire drill situation so she is confident about waiting for assistance next time).

[7] see http://www.dbh.govt.nz/bomd-earthquake-prone-buildings

In general, people with disabilities in the Pilot Workshops demonstrated high levels of self-reliance and serious attitudes to fire safety. While some people imagined they might think about whether the alarm could be a false alarm or drill, most indicated they would pretty quickly assume a real emergency was occurring. These attitudes persist despite people's previous experiences of drills and false alarms.

In one workshop, health researchers described likely responses of people with dementia. Because they are more prone to panic, they are likely to find the noise of an alarm overwhelming and get agitated. They are also likely to be bewildered, are unlikely to understand what is going on and would not know what to do. For a person with dementia, the alarm sound can be piercing and unbearable and can make the situation too difficult for them to think through what to do.

Participants with hearing disabilities pointed out that they would have more difficulty knowing something was going on, especially if they were on their own (e.g., in a toilet). In the absence of visual alarms like flashing lights, they would have to rely on the body language and other reactions of people around them and the arrival of wardens.

4.1.2.2 Initial Action After Alarm

Participants' anticipated first movements reflected a mix of:

- Their individual resilience characteristics and experiences (it seems that participants who have lived with their impairments from birth are particularly independent);
- Their degree and type of impairment (for instance, some with more restricted movement said they would wait before doing anything, mainly to avoid creating hazards for others);
- Whether they are responsible for others in the emergency situation (e.g., children) or with others they might worry about;
- Whether they are with people (e.g., carers, interpreters, a guide dog) who could help them; and
- The type of environment they are in (e.g., a mall could be a more hazardous environment because of its size, complexity and crowdedness).

Most people would initially look for the nearest exit to a place outside that they felt would be safe. Ironically, the search for emergency exits is not something people might normally do when they enter a building or a complex of buildings like a mall. For instance, several parents and grandparents said their first priority when they enter a mall is to find the sign to the toilet. One parent jokingly said that toilets needed to be 20 seconds away from where he was with his young children at any one time.

People's ability to identify emergency exits varied. Not everybody recognised the 'running man' as signalling an emergency exit. A number of participants wondered why there is not also the word 'exit' accompanying the sign. People with hearing or sight impairments also need voice alerts (e.g., "Evacuate the building now!") and strobe lighting as an integral part of emergency egress signs.

People who came to a building via an elevator would look for an alternative route on the assumption that they could not use the lifts. Some said it was their understanding that elevator use was not allowed in an emergency and reserved for firefighters. Some mentioned they were scared that they would be stuck in them should there be a power cut (and they seemed to assume there always would be). Some stated that they feared the elevator could take them to (open at) danger like the seat of the fire.

As well as looking for the emergency exits, those with physical disabilities would look for ramps or other equipment or mechanisms (e.g., evacuation chairs, wheelchairs, etc.) to

help them get out. Participants' experiences would suggest that people with disabilities (and their potential assistants) get few, if any, opportunities to practice using such equipment. They also said that they do not necessarily know whether there are mobility aids and where they might be located.

Initial actions could include looking around for a warden or someone (e.g., building management, other staff) who could help them by, for instance, providing leadership and guidance.

Parents and grandparents with children said that they would initially get the children ready to move – get them out of a highchair or buggy, pack up bags. They also said that they would ensure they had physical hold of their children if they had moved away (e.g., older children who might have gone to buy an ice-cream, etc.).

4.1.2.3 Prompts That Produce Movement

Most participants would assume that the alarm indicated a real fire even if they suspected it was a false alarm or drill. They talked about both what would make them move and what they might do rather than where they would go. It is interesting that some would still like some concrete sign that there is an emergency despite previously talking about taking alarms pretty seriously. Their decision to take action would be prompted, or further supported, by evidence of the emergency (including the continuation of the alarm and signs such as smoke or smell). Some of the more able-bodied participants thought they would investigate the nature of the fire before deciding what to do. People's action would also be influenced by the behaviour of others, the guidance and advice given by people in fire safety roles (e.g., wardens) and how other people were responding.

Most importantly, people want information and guidance from those in authority, especially fire or safety wardens, and others in the building, so that they can respond appropriately.

4.1.2.4 Routes Taken

As discussed, a mix of a continuing alarm, other people reacting to the alarm and the arrival and/or advice of wardens and others would prompt people to move. Their response and the place they would head for (what they see as the best place to go) would depend on a mix of:

- Information or advice they were given by wardens, etc.;
- The content of any announcements;
- Wayfinding mechanisms such as exit signs, arrows or maps;
- The nature of any disability (their own or that of family or companions);
- The actions and chosen routes of others;
- Whether they were responsible for others' safety (e.g., children); and
- For some people with physical or sensory disabilities, maybe searching out a route that is less crowded because crowding can be a hazard.

Participants' anticipated routes, to some extent, also reflected their degree of familiarity with the buildings/complexes included in the workshop scenarios. Although most respondents indicated that they would locate the emergency exit or nearest way out as part of their initial reaction to the alarm, a minority anticipated leaving the way they arrived. Almost always, people indicated they would not take the elevator (as discussed above).

Discussion about emergency routes also included discussion of building design. Participants pointed out that safe egress depends on a well-designed building with well-

designed accessibility features that are not ‘tacked on’. Conversely, safe egress is undermined when accessibility is not taken seriously. Accessibility and egressibility need to be integral to the overall design of a building or complex and not provided as a ‘bolt-on’. As one participant in a wheelchair noted: “Building design needs to be inclusive. A failure to plan for the entry in of people with disabilities, plans them out.” The ease with which people with disability can get into a building will shape how easy it is for them to get out in an emergency.

4.1.2.5 Factors Taken into Account Before Moving

The sorts of factors that workshop participants would take into account before moving include the following:

- What might be the best (and not necessarily the nearest) exit (i.e., the one that leads away from the emergency event and to a safe place);
- Where there may be possible obstacles (including the behaviour of others that could create obstacles) or where the participant may become an obstacle to others;
- What the condition of the floor is like (i.e., slipperiness and freedom from obstacles);
- Where exit routes may end up; and
- The location of companions/family members.

The responses of parents and grandparents show the special complexity of decision-making and the potential difficulties in safely egressing that people responsible for children could face in an emergency event. They anticipated simultaneously:

- Calming children,
- Trying to quell their own panic,
- Answering children’s questions,
- Collecting the children together,
- Holding on to them,
- Stopping them from running off (or capturing those who have), and
- Moving with the crowd to enable them to cope with their dependents.

They described themselves together with their children as like a disabled person and outsized. With a child on each hand they are potentially wider and slower than an average person and would need more room to move.

4.1.2.6 Seeking of Assistance

Participants’ varied in their expectations around seeking help. Some anticipated actively seeking help and others expected they would be more reticent, not wanting to be a nuisance. While some people would actively seek help in an emergency situation, most anticipated getting to safety without assistance. In general, people’s need to ask for help would depend on their type and severity of impairment. And who they sought help from would depend on the circumstances – so they might seek it from a warden or from a nearby able-bodied person. The latter is the most likely.

People were also aware of their ability (and responsibility) to provide help. However, they noted that it is not always easy to recognise impairment and, hence, those who could need help. They reported they would know to offer help to anyone with an obvious disability, anyone who seemed to be not moving, anyone who had been injured and

anyone who looked frightened. But they were aware that they could overlook others potentially needing help, for instance those with dementia.

4.1.2.7 Suggested Solutions

The approach to safe egress in a fire that research participants suggested provides the basis for what they point out. It is the right of people with disabilities to have the ordinary lives to which everyone is entitled. In one workshop, participants pointed out it is useful to remember that everyone is potentially disabled on a temporary or permanent basis. One participant stated that we can think of the population as temporarily able-bodied.

4.1.2.7.1 Universal Design

Buildings need to be designed in an integrated way with universal design elements and protocols that ensure safe accessibility and egressibility for all, including disabled people. Some participants considered that such design elements should be mandatory, regardless of the age of the building, as they benefit everybody. Otherwise, as one participant pointed out, “if you don't plan us in, you plan us out”. Having accessible entry and exit provisions that enable and encourage everyone to use and enjoy the built environment (including individual buildings) makes buildings more usable and economically viable over their lifetimes.

Design elements include:

- Readily available (and accessible to all) information (e.g., signage, verbal information, visible and readable maps, etc.) about evacuation processes for everyone – including people with disabilities, with children, etc. This includes universally-recognised signage that shows the location of emergency exits and travel routes and places of safety/refuge in a building.
- Stairwells that are large enough for people with disabilities to wait for assistance without blocking the movement of others.
- At least one safe access route that enables people with disabilities to be self-reliant and self-evacuate where possible in an emergency. This needs to be designed based on the principle that the better the accessibility the better the egressibility and to take account of the slower pace of evacuation by those with disabilities. The route could include ramps, emergency exit doors and other provisions that can be operated by everyone.
- Audio visual alarm systems that will alert everyone to an emergency – e.g., flashing lights for people with hearing disabilities, voice-activated warnings for people with sight impairment, etc.
- Protocols for the provision and operation of evacuation chairs. Provision of training in their use for users and helpers and practice opportunities to reduce anxiety in emergency situations. If evacuation chairs are provided they are needed on every level and spare wheelchairs may be needed at their final destination point for the user to transfer into.
- Protocols for the maintenance of an up-to-date register of building users (including visitors) who may need assistance in an emergency.

4.1.2.7.2 Disability Awareness-Raising and Education

Trained wardens and other safety personnel:

Wardens and other related safety staff play an essential role in ensuring people’s safety during an emergency. Therefore they need education and training to ensure they are

sensitive to the needs of groups whose safe egress may be more difficult in an emergency. These groups include:

- Parents and others responsible for children,
- People with physical, sensory and cognitive disabilities,
- Carers of those with disabilities, and
- Others whose egress in an emergency may be hampered.

People may not look like they need help (e.g., people with dementia, people with hearing disabilities, etc.). This is why fire wardens also need training so that they recognise and respond appropriately to signs of stress and anxiety.

Standardised training of wardens could also be used to manage expectations of the public who need to know:

- How to identify wardens,
- How to respond to a warden,
- The common messages to expect, and
- How to request assistance.

The public:

Government-funded disability education and awareness-raising needs to be provided through a range of channels including schools and the media and using a variety of sophisticated mechanisms including social marketing. Such awareness-raising is needed to get widespread societal support and manage user expectations/ understanding for a built environment that is user-friendly and safe for everybody. This also include more specific things such as information about new safety protocols when they are introduced (e.g., the internationally-used 'running man' symbol).

Building users

Education is needed to encourage self-advocacy/self-reliance in emergency situations among the public so that people can self-evacuate if at all possible in an emergency. Content could include information about safety measures in specific places and buildings that will assist their safe egress (e.g., maps, emergency exits, equipment available, etc.). It is not enough to just provide these measures to encourage self-reliance. People need to know what they are and where they are.

Central and local government:

Awareness-raising about the needs of people with disabilities could be a core part of staff competencies to promote and ensure better service and amenities provision (e.g., in local and central government agencies). Government organisations could then provide a role model for other organisations providing services to people with disabilities so that, eventually, all are sensitised to the needs of everyone in their communities.

4.2 Voids Identified in Current New Zealand Regulations and Guidelines

This section discusses concepts raised by participants where international requirements or guidance provide additional normative or informative content that would complement requirements not currently addressed in the New Zealand regulations and guidelines. Concepts discussed include:

- Alarms, particularly requirements around pre-recorded voice notification;
- Wayfinding, particularly signage;
- Training, particularly of staff/wardens and evacuation training programmes;

- Egress routes, particularly about evacuation chairs, ramps, and elevators; and
- Areas of refuge/for assisted rescue, particularly signage and instructions on use.

4.2.1 Alarm – Pre-Recorded Voice Notification

International information on voice messages is provided in ISO 21542 (2011). It is recommended that a short message is to contain appropriate warning information which is easily assimilated. It is suggested that the speaker is to be distinct and easy to understand (NZS4512:2010, Section F4). In addition, messages are to be provided in at least two different languages. (ISO21542 2011, Sections 34.3 and 39.4)

4.2.2 Wayfinding – Signage

International requirements and guidelines provide addition information on signage. Parameters include:

- Light reflectance values (LRV) of an environment, adjacent colours, surfaces, information and potential hazards to provide discernible visual contrast of surfaces. (ISO21542 2011, Section 35, ANSI A117.1 2009, Annex B.7)
    - Minimum difference in LRVs for small targets, like signs and inscriptions, to signboards, is to be 60 points. (ISO21542 2011, Section 40.6)
    - It is noted that reflections and glare may confuse people with vision impairments. (ISO21542 2011, Section 35) (ANSI A117.1 2009, Annex B)
    - Many visually-impaired people can perceive light and dark (ANSI A117.1 2009, Annex B.7)
- Signs are to be readable and legible for people who have vision or mental impairments. (ISO21542 2011, Section 40)
    - Information with text is to be supplemented with graphical symbols to facilitate comprehension for everyone. (ISO21542 2011, Section 40)
    - Signs should be readily understandable. They should be designed so as to be simple and easy to interpret. The message should be unambiguous, utilising short sentences and simple words. Abbreviations and very long words are hard to understand and are to be avoided. (ISO21542 2011, Section 40.9)
    - Only essential information is to be included on a tactile map or floor plan. The map is to be orientated with the building. (ISO21542 2011, Section 40.14)
    - Font style is to be a sans serif font similar to Helvetica or Arial medium. The letter height depends on the reading distance. (ISO21542 2011, Section 40.5)
    - Signs are to be provided in relief and Braille. (ISO21542 2011, Section 40)
- Well-illuminated, clear and readable signs are to be placed at a consistent height. (ISO21542 2011, Section 40)
    - Communication systems are to be placed on the wall adjacent to the latch side of the door and preferably in a range of 1000 mm-1200 mm above ground level. (ISO21542 2011, Section 40.2)
    - Directional and functional signs should be located below 1600 mm where they are easy to approach, touch and read the raised elements with the fingers. (ISO21542 2011, Section 40.4)
- Stairwells are to have information signs (ISO21542 2011, Section 40.2):

- All points of entry and exit are to be identified.
- Floor numbers shall be located on each floor at top and bottom of stairs, on handrails and on each side of the outer frame of each lift car entrance on each floor. They can be prominently displayed elsewhere so they are visible from the lift car at each level.

- Signage indicating special egress-related accessibility provisions:
  - Each door providing access to an area of refuge from an adjacent floor area shall be identified by a sign. Each door providing access to an exterior area for assisted rescue shall be identified by a sign. (IBC 2012, Section 1007.9)
  - Raised characters and Braille signage complying with ICC A117.1 shall be located at each door to an area of refuge and exterior area for assisted rescue (IBC 2012, Section 1011.4)
  - Direction signage indicating the location of the other means of egress which are accessible means of egress are to be provided at the following (IBC 2012, Section 1007.10):
    - Exits serving a required accessible space but not providing an approved accessible means of egress.
    - Elevator landings.
- Within areas of refuge.
  - In areas of refuge and exterior areas for assisted rescue, instructions on the use of the area under emergency conditions are to be posted. The instructions shall include all of the following (IBC 2012, Section 1007.11):
    - Persons able to use the exit stairway do so as soon as possible, unless they are assisting others.
    - Information on planned availability of assistance in the use of stairs or supervised operation of elevators and how to summon such assistance.
    - Directions for use of the two-way communications system where provided.
- Further guidance for:
  - Wayfinding and signage is included in ICC/ANSI A117.1, ISO 16069, ISO 28564-1, ISO 7000, ISO 7001 and ISO 7010.
  - Tactile walking surface indicators (TWSIs) is included in ISO 21542 2011, Annex A, and ADAPBS Guideline 2013, page 91.

4.2.3 Training

4.2.3.1 Staff/Wardens

International requirements and guidelines provide additional information on trained staff or wardens for assistance in wayfinding.

In consideration that independent evacuation may not be possible for all occupants, there may need to be specific strategy and areas of rescue assistance. This is particularly true for those occupants who need assisted evacuation (ISO 21542 2011, Section 38.3).

For elevators to be included in a building evacuation scheme, ISO 21542 (2011) Section 15.6 recommends a suitable number of trained and experienced fire wardens should be

designated on each floor. They should be trained to carry out their duties in a fire emergency and be available at all times when the building is occupied[8].

ISO 21542 (2011) Annex D.2 notes that it is essential that every firefighter is fully aware of and is regularly trained in the range of rescue procedures involving people with disabilities. While firefighters may have the specialist knowledge, the building wardens are needed to provide the accurate and timely information of the location and needs of occupants waiting at areas of refuge.

4.2.3.2 Evacuation Training Programme

In support of the raised suggestion of evacuation training of the occupants, evacuation skills are described in ISO 21542 (2011) Annex D.4. It says “ability of a person, resulting from adequate training and regular practice, to carry out complex, well-organized patterns of behaviour efficiently and adaptively, in order to achieve some end or goal”.

Information in Annex D.4 lists that occupants are to know: the location of places of safety; how to get to them; and distances from the building that are considered safe. Occupants are also to participate in non-emergency drills to develop building specific skill.

Furthermore, it is stated that, “fire protection measures and human management systems are never 100% reliable. It is necessary, therefore, especially for people with activity limitations and/or impaired senses, to be familiar with necessary guidelines for self-protection in the event of a fire emergency”. (ISO 21542 2011, Annex D.4)

An example of a Personal Emergency Evacuation Checklist is provided in NFPA (2007).

4.2.4 Egress Routes

4.2.4.1 Evacuation Chairs

In consideration of the concerns raised about gaining practical experience with the use of evacuation chairs, it is noted in ISO 21542 (2011) Section 15.6. It says that manual handling of wheelchairs occupied by their users in a fire evacuation staircase is hazardous for the person in the wheelchair and for people providing assistance. Furthermore, it is suggested that the weight of an average unoccupied powered wheelchair alone makes manual handling impractical.

In ISO 21542 (2011) Section 15.6 evacuation chair devices are discussed in terms of practicality of use for the wheelchair user. Some evacuation chairs require a wheelchair user to transfer out of their own chair into the device. It is acknowledged that this transfer operation requires manual handling by others that is accompanied with a risk of injury during the transfer process. It is further noted that the transfer may infringe the independence and dignity of the individual concerned.

4.2.4.2 Ramps

Information on fire isolated ramps are included in ADAPBS Guideline (2013). Practical provisions for ramps are described in ISO 21542 (2011) Section 8, including maximum slope and length before elevators are to be required.

4.2.4.3 Elevators

To address concerns of user independence and dignity, ISO 21542 (2011)[9] Section 15.6 recommends that all elevators in new buildings are to be capable of being used for

[8] Note that if elevators were to be used in evacuation schemes, then these would need to be designed specifically for this purpose (e.g., complying with ISO/TS 18870 or ASME A 17.1, etc.)

[9] Details of elevator design that would be used in this type of application is included in ISO/TS 18870, with supplementary information provided in ISO/TR 25743

evacuation in a fire situation. When elevators in existing buildings undergo a major overhaul or are replaced they are to be made capable of use for evacuation.

Guidance for operation includes for the elevator used for evacuation to continue to operate effectively and safely, under strict building management, for a specified time during a fire. Firefighting elevators would be used for the evacuation of building occupants up until the time that firefighters arrive at the building and take control of the elevators. However, some international jurisdictions require separate provisions for firefighter access and accessible egress. This approach would require liaison and pre-planning with local fire authorities to agree suitable procedures with regard to this use of the elevators (ISO 21542 2011, Section 15.6 and Annex D.3). Further information on elevator requirements for use as an accessible means of egress is included in IBC (2012) Section 1007.4 and ASME A17.1 Section 2.27.

Elevators designed to be used for evacuation are to be easily accessible, clearly identifiable and suitably protected from the entry of smoke, heat and flame. The controls for the lift are to be located in the areas where users must wait in a tenable environment provided at all times during evacuation. (ISO 21542 2011, Section 15.6)

Further suggestions are for the location of elevators designed for evacuation in a building to be, preferably, outside a central position on plan and to be supported by fire evacuation staircases. They are also to be provided with associated areas of rescue assistance and direct protected access to final fire exits leading to places of safety.

4.2.5 Areas of Refuge/for Assisted Rescue

Internationally, areas of refuge and exterior areas for assisted are provided as temporary safe places within a building where occupants may wait for assisted rescue (ISO 21542 2011, Section 38.3.2; IBC 2012, Section 1007.7; and more detail is summarised in Appendix D.2).

An area of refuge and an exterior area of assisted rescue have different fire safety requirements. For example, exterior walls separating the exterior area of assisted rescue from the interior of the building are to have a minimum fire-resistance rating of one hour (rated for exposure to fire from the inside). This requirement extends horizontally 3048 mm beyond either side of the landing (IBC 2012, Section 1007.7.4). The sides of the exterior area for assisted rescue, other than the walls separating the area from the inside of the building, is to be at least 50 percent open. The open area is to be distributed to minimise the accumulation of smoke or toxic gases (IBC 2012, Section 1007.7.5). For unsprinklered buildings, stairways that are part of the means of egress from the exterior area for assisted rescue are to have a clear width of 1219 mm between handrails (IBC 2012, Section 1007.7.6).

Communication systems are required to be provided in areas of rescue assistance in a building (ISO 21542:2011, Section 38.3.2). These communication systems are to be an accessible and reliable independent communication system facilitating direct contact with a person in the designated control room for the building during an emergency. In addition, communication systems at areas of rescue assistance (ISO 21542:2011, Section 38.3.2) are recommended to provide visual feedback to people with hearing impairments that their location has been noted.

In both areas of refuge and exterior areas for assisted rescue, instructions on the use of the area under emergency conditions is to be posted, including all of the following (ISO 21542:2011, Section 38.3.2; IBC 2012, Section 1007.7.11):

- Persons able to use the exit stairway are to do so as soon as possible, unless they are assisting others.
- Information on planned availability of assistance in the use of stairs or supervised operation of elevators and how to summon such assistance.

- Directions for use of the two-way communications system, where provided.

IBC 2012, Section 1007.7.2 allows an exterior area of assisted rescue to be permitted as an alternative to an area of refuge, where exit access is essentially open to the outside.

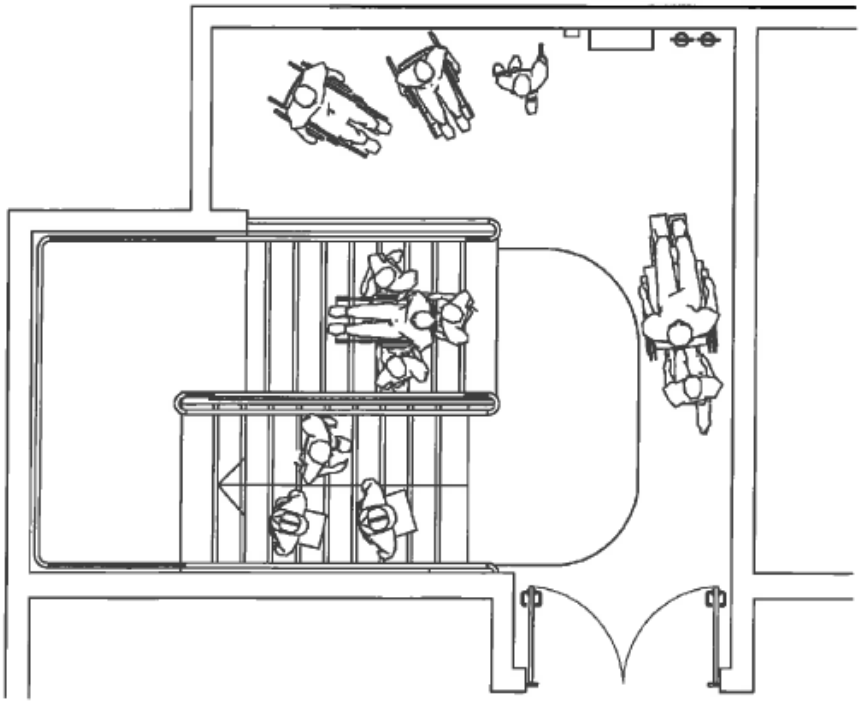

Figure 1. Example of fire evacuation staircase (ISO 21542:2011, Figure 62)

4.2.5.1 Signage for Areas of Refuge/Rescue Assistance

Internationally-required signage for areas of refuge/rescue assistance include:

- To be clearly indicated with good signage (i.e., wayfinding to the area) (ISO 21542:2011, Section 38.3.2)
    - Signage at each door providing access to an area of refuge from an adjacent floor area is to be identified by a sign stating: AREA OF REFUGE. (IBC 2009, Section 1007.9):
- Instructions on the use of the area under emergency conditions are to be posted, including (IBC 2009, Section 1007.11):
    - Persons able to use the exit stairway do so as soon as possible, unless they are assisting others.
    - Information on planned availability of assistance in the use of stairs or supervised operation of elevators and how to summon such assistance.
    - Directions for use of the two-way communications system is to be posted adjacent to the two-way communication system. (IBC 2009, Section 1007.8.2)
- Directional signage indicating the location of the other means of egress and which are accessible means of egress shall be provided (IBC 2009, Section 1007.10):
    - At exits serving a required accessible space but not providing an approved accessible means of egress,
    - At elevator landings, and

- Within areas of refuge.

- Areas of refuge are to be equipped with hands-free, two-way communication that provides an audible and visible signal to indicate communication has occurred. It is also able to indicate to the receiver the location sending the signal (ISO 21542:2011, Section 38.3.2; NFPA 72, 2013, Section 24.5.3.6). This system is to:
    - Have a connection to a central control point or a constantly-attended monitoring location (ISO 21542:2011, Section 38.3.2; NFPA 72, 2013, Section 24.5.3.3),
    - Be provided at the elevator landing on each accessible floor that is one or more storeys above or below the storey of exit discharge. Except this is not required (IBC, 2009, 2012, Section 1007.8):
        - At an elevator landing where the two-way communication system is provided within areas of refuge (e.g., stairwell areas of refuges), or
        - On floors provided with ramps for egress.

Additional information is also included in ANSI A117.1 (2009) Section 708 and examples of signage is included in IBC (2012).

4.3 Pilot Workshop Format – Value of Pilot Workshops

During the preparation and review of the Pilot Workshops, the value of the workshop format for raising fire safety awareness amongst research participants was considered. In the second Christchurch workshop, for instance, participants were asked to describe any changes they had made to their behaviours or built environment in response to the first workshop three months previously.

As suggested by Argueta and Glasgow, interactive information sharing (like workshops) tends to have better results overall than one way communication (Argueta et al. 2009, Glasgow 2006).

Research participants' feedback in this research bears out these findings. Here are some examples of positive change coming out of the workshops:

- The parents who participated reported that they would be more focused on finding emergency exits and exit routes in malls and other public buildings;
- Participants in another workshop reported that they would seek out opportunities (as users and helpers) to practice using egress aids such as evacuation chairs;
- Participants in one workshop reported feeling more confident about their future lobbying for safety and disability-friendly improvements in a local mall. It is both because the workshop provided the basis for relationship building between themselves and mall operations management and because the operations manager had a better understanding of disability issues; and
- Two participants used their new understanding as bases for (i) a focus on fire safety in a regular newspaper column and (ii) sending out a fire safety-related message to an organisational mailing list.
- One gentleman in Christchurch reported using his new understandings to make significant changes to his earthquake repairs design to include better fire safety and egress features.

5. CONCLUSIONS

An analysis of the Pilot Workshop and interview outputs highlight the following key items:

- There was a general assumption amongst research participants that areas of refuge are located on the landings of all/any stairways or in front of all/any elevators. This assumption may lead to individuals needing to be searched for or being overlooked because the designated areas of refuge may not include all of these assumed areas.
    - Clear identification of areas of refuge, use and instructions provided as to the intended operation of these areas (e.g., IBC 2012, Section 1007.8, Section 1007.11, etc.).
    - Public education on the identification of these areas and intended use.
- There is general agreement that there needs to be standardised training of wardens that includes awareness-raising about the needs of people with disabilities.
    - Standardised training of wardens.
    - Public education of what to expect from a warden and general information on offering and providing assistance to others.
    - Opportunities are needed to ensure users and potential assistants are familiar with the operation of evacuation assistance devices. Providing opportunities for experience in the use of these devices in a non-emergency situation.
    - Including individuals that may require assistance in all stages of drills.
- Misconceptions about fire safety systems and how they work amongst some research participants (e.g., activation of a sprinkler system throughout a building during an incident) may cause undue worry.
    - Public education on common building fire safety features and how they can be expected to operate during a fire would assist to alleviate these undue concerns.
- Unintended benefits from the Pilot Workshops included raising participants' awareness of their own fire safety and that of their family and colleagues and how they could become better prepared.

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APPENDIX A PILOT WORKSHOP TERMS OF REFERENCE

Summary Terms of Reference –
Accessible Emergency Egress – Phase 2: Pilot Workshops

Project Title	Accessible Emergency Egress – Phase 2: Pilot Workshops
Core Research Team	Amanda Robbins, PhD, APEC Engineer, MSFPE (Jensen Hughes Consulting Canada Ltd., Canada) Julie Warren (Julie Warren and Associates Ltd, New Zealand) Greg Baker (BRANZ Ltd, New Zealand)
Funding	BRANZ Ltd via the New Zealand Building Research Levy
Project Duration	May 2013-May 2015

Overall Description:

This project addresses three interrelated problems/issues:

1. *Egressibility*: The need for accessibility for emergency egress has been identified internationally[10]. In New Zealand, accessibility requirements are currently specified for some buildings, but these do not include requirements for emergency egress. Accessibility requirements are mandated by New Zealand building regulations for buildings that are accessible to the public[11]. However, these requirements do not extend to situations of emergency egress from the same buildings (e.g., evacuation plans, management, exit ways, etc.). See Paragraph 1.4.5.2, NZS4121 2001. Emergency egress may be needed in a variety of circumstances including after an earthquake where the structure is intact, during a fire event or a practice evacuation drill, etc. A common method of providing access in multi-storey buildings is the installation of elevators but these are typically not available for evacuation in the event of a fire or earthquake. The research focuses on fire safety as a case study for safe egress in an emergency situation. Fire safety is often the basis for emergency egress design and management, and is then implicitly assumed to be sufficient for all emergency scenarios.

2. *Demographic, technological and social trends*: Accessibility needs to be considered in the context of the characteristics of the intended users of a building. People's physical capabilities, for instance, potentially affects their safe egress from a building during an emergency situation if the building is not designed considering the range of characteristics of the intended users. The distribution of such characteristics is likely to change with, for instance, changes in the composition of the New Zealand population (as it ages), medical and technological advances and increasing housing density. As the population ages, there will be a greater proportion of people over 65 years and, therefore, potentially more people with physical and other impairments. Developments in medicine and technological mobility and sensory aids, coupled with changing personal aspirations, supported by changing health policies, may also affect the distribution of building occupant/user characteristics by enabling or encouraging more people to live independently for longer (rather than in age care and other specialised care facilities). Increasing pressure for high-density housing (e.g., in Auckland), with more people living in the city centre in multi-storey buildings, may also affect the distributions of building user characteristics and the design and use of residential, community and other buildings.

[10] For instance, see http://www.access-board.gov/evac.htm, www.nfpa.org/disabilities, ISO 21542:2011 Building construction – Accessibility and usability of the built environment, (U.S.) National Fire Protection Association (NFPA) Fire Protection Research Foundation (FPRF) research agenda.
[11] Accessibility for residential housing is voluntary.

3. *Lack of sufficiently-nuanced building user characteristics data and other information*: Buildings designed to meet the changing needs of intended users (e.g., residential buildings targeting retirees, halfway/rehabilitation houses, community housing, etc.) are designed for life safety in a context of inadequately specified and characterised building occupancy/user expectations. For instance, occupants/users are typically assumed to be a 'general cross-section of the population' or 'average of the population'. Therefore, expectations about their ability to exit a building in an emergency are based on estimates of an average healthy adult's ability to do so. One contributing problem in relying on available datasets is the lack of data on the capabilities of particular sectors other than average healthy adults (e.g., their speed of movement, obstacle negotiation, etc.).

   The New Zealand 2006 Disability Survey (NZ Statistics, 2007) provides an important dataset about the distribution of disability in the population. However, that it potentially underestimates disability levels in New Zealand, further compounds problems around the adequacy of data. For instance, a self-reported 17% of the population with disabilities is probably an underestimate as individuals with reduced capabilities may not have self-identified as 'disabled'. Two groups who probably under-reported their disabilities, and were therefore not captured in the data, include older people who typically see their impairment as part of the ageing process and individuals with medical- or situational-induced incapacities of a temporary or short-term nature (e.g., broken leg, pregnancy, heart condition, parent with a pram, etc.) who do not identify as disabled. Thus, use of such data as an estimate of disability in the design of accessibility and egressibility of buildings is problematic.

   New Zealand currently leads the world in performance-based fire engineering (Meacham, 2011). However, design work for accessibility and egress is problematic both here and internationally because of the lack of information/data available to develop prescriptive or performance requirements that would be appropriate for regulations around emergency egress.

The Key Research Objectives:

Overall project objective:

1. Understand the population of New Zealand and how buildings are used in emergency situations, now and in the future, (e.g., as urban densities increase with more multi-use, multi-storey buildings being used by a changing population with a wider range of capabilities) to inform building design tools, guidelines, standards and regulations.

The Pilot Workshop objectives that will contribute to this overall objective:

   a. Collect experiences, ideas and information (e.g., both positive and negative) from individuals and groups related to egress from current buildings.
2. To engage participants, so that following their workshops participants have:
   a. a mechanism to share new/additional ideas and experiences,
   b. the opportunity to participate in future/additional workshops, and
   c. access to the reported learning and outcomes that are from the workshops.
3. Collate and utilise the learning experiences from these Pilot Workshops to inform and develop future workshops and similar information gathering.

Research Approach and Methodology:

The research project is designed to identify and collect data and focused solution examples where possible. The building design context is New Zealand focused, with international perspectives used to provide additional breadth. The project is structured around the four phases described below.

Phase 1 (completed): *Literature review* of the New Zealand and international research (Robbins and Buckett, 2014), the results of which provide both a stage gate for Phase 2 and an initial summary of potential solution approaches.

Phase 2 (currently underway): *Interviews, focus groups and Pilot Workshops* to canvass the collective knowledge and experience of individuals, NGOs and government organisations with an interest in building accessibility and safety (including for specific occupancy/user groups). Participants will include (but are not limited to) regulators, Accident Compensation Corporation, New Zealand Fire Service, Human Rights Commission, disability groups, senior citizens and aged care groups, universal design experts, and health and disability professionals. Phase 2 is intended to:

- Identify data/measures currently used to describe relevant population sectors/groups and the availability of this data for inclusion in post-workshop analysis.
- Collect information as a basis for (i) mapping target (i.e., those with physical and other permanent or temporary impairments) building occupant/user capabilities, needs, self-rescue capabilities and expectations and institutional rescue capabilities and expectations, and (ii) potentially informing performance-based design.
- Rank preferred building design options and evacuation plan approaches identified in Phases 1 and 2.
- Identify gaps in data and other information characterising targeted building occupants/users and specification of information and the need for alternative solutions.

The selected design data and solutions may be informed by (i) adaptation of data/measures currently collected and/or used by workshop participants to describe population sectors/groups (e.g., accident data, health care, insurance, etc.) and (ii) research participants' experiences of problems and practical solutions relating to building egress.

The workshop experience and outcomes will also inform any recommendations relating to future workshop programmes.

Phase 3: *Post-workshop analysis* and summary of workshop results to:

- Map target building occupant/user capabilities, needs, self-rescue capabilities and expectations and institutional rescue capabilities and expectations.
- Rank preferred building design options and evacuation plan approaches and make recommendations for optimum potential solutions.
- Identify data gaps and solutions.
- Summarise results in a report format.

Intended Project Outcomes:

1. More informed lobbying by groups/organisations through provision of a resource (e.g., published project findings and recommendations in summary form). Lobbying may lead to change such that emergency egress accessibility requirements will be more appropriate and clearly addressed in regulations and fire safety requirements relating to accessible emergency egress will be addressed.

2. Economic benefits arising from a reduction of emergency egress-related injuries and deaths and improved usability of buildings.
3. Social benefits arising from buildings that are more appropriately designed to preserve life by allowing more efficient egress for building users and occupants.
4. Informed and integrated design through improved knowledge in occupant characteristics and potential accessible fire safety solutions leading to improved practice in fire safety design and accessible building design.

Project Intent:

Completion of a successful project will be realised by the reported results being publicly available and used by multiple parties throughout the industry and wider community to promote and implement positive change in building design attitudes and, ultimately, regulations for appropriate and functional egress design based on intended building user characteristics.

Participants in the Pilot Interviews, Focus Groups and Workshops:

There will be a number of partners involved in the project. These partners will be contributing to the project through:

- participation in the planning phase of the workshops,
- participation in interviews, focus groups and the targeted workshops, and
- review and feedback on the results of the project before final dissemination of the results.

Research participants' involvement in various aspects of the research may vary depending on their interest and time and other resources. However, it is hoped that all participants can contribute to the review process before final dissemination.

Examples of Stakeholders, Target Audience and Interview and Workshop Participants Include but are Not Limited to:

Government departments and organisations:

- Regulators – Ministry of Business, Innovation and Employment (MBIE), Building and Housing Group – delegates for participation in the workshops and feedback sessions
- Accident Compensation Corporation (ACC) – delegates for participation in the workshops and feedback sessions
- Human Rights Commission, Disability Commission – in particular, regarding the Canterbury rebuild for accessibility
- Ministry of Social Development (MSD), Centre for Research and Development, concerning disability and ageing – delegates for participation in the workshops and feedback sessions

Fire Service:

- New Zealand Fire Service – delegates for participation in the workshops and feedback sessions, potential use of teleconferencing facilities at locations around the country, potential co-funding.
- New South Wales Fire Brigade – delegate for remote participation in the workshops and feedback sessions, potential for partnership for ARC grant application.
- US Fire Administration (USFA), Federal Emergency Management Agency (FEMA) – knowledge and experience: information on building regulations and best practice across the US and firefighters' experience of effective and inhibiting (and the related situations for which they were in) accessible building egress design solutions.

Designers: participation in planning and workshops

- Lifetime Design/Universal Design
  - Lifemark
  - Barrier Free Trust
- Fire Safety Engineering Design
  - New Zealand branch of the Society of Fire Protection Engineers (SFPE)
  - Institute of Professional Engineers New Zealand (IPENZ)

Community Representatives:

- Disability Groups: participation in targeted workshops
- Health and Disability Professionals: participation in targeted workshops
- Aging Groups: participation in planning and workshops
  - Aged Concern, Grey Power, Stroke Groups
- Early Childhood Groups: participation in targeted workshops
- School/Parent Groups: participation in targeted workshops
  - Teachers groups (i.e., interested in the context of when they have students with a temporary or long-term disability during field trips, etc.)
  - School groups (i.e., interested in the context of events etc. held at the school that may include people with temporary or long-term disabilities)
  - Parent groups (i.e., interested in the context of taking their children into other buildings, e.g., museums, shopping centres, etc.)
- Tourism Groups: participation in targeted workshops

References

ISO 21542. 2011. Building construction – Accessibility and usability of the built environment. International Organization for Standards. Geneva, Switzerland.

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NFPA. 2012. People with Disabilities. Address: www.nfpa.org/disabilities. National Fire Protection Association. Quincy, MA, USA.

NZS4121. 2001. Fire Safety (Evacuation of Buildings) Regulations. Standards New Zealand. Wellington, New Zealand.

Robbins, A. P., 2011. Fire Design for Aging Residential Occupancies, Fire Research Report No.115, (BRANZ SR 245). New Zealand Fire Service Commission. Wellington, New Zealand.

Robbins, A. P., and Buckett, N. R., 2014. Accessible Emergency Egress – Literature Review and Scoping Study. BRANZ Study Report 318. BRANZ Ltd. Judgeford, New Zealand.

Statistics New Zealand. 2007. 2006 Disability Survey. Wellington, New Zealand.

USAB. 2012. Guidelines and Standards. United States Access Board, A Federal Agency Committed to Accessible Design. Washington, D.C., USA.

APPENDIX B EXAMPLE SCENARIOS

Example scenarios for Pilot Workshop discussions are summarised in the following sections. These frameworks were used for orientation of the Pilot Workshop facilitator and were not directly used in presentation to the Pilot Workshop participants.

B.1 Scenario A: Pilot Workshop Room

Scenario	A
Brief description	In the Pilot Workshop room – where we are right now
Tell me how to get out of here	1. Tell me how you would get out of here. 2. Now tell me how you would get out of this room in an emergency. 3. If the alarm went off this moment, which way might you be more likely to go? 4. If the alarm is going off, what is the first thing you think of? 5. If you are told to evacuate this building right now, what do you dread the most? 6. If the alarm was sounding and you were told that you cannot move from here. If I told that you need to wait for a firefighter to come, while I directed everyone else to leave, what would you do? a. If you would wait, why? What is here that gives you a sense of safety? b. If you wouldn't wait here, what would you need to stay in place? i. To have notification from the building PA to stay in place? ii. To be told that someone is coming? 1. Does it matter who is coming? 2. Does it matter how long they will take to get to you? 3. How will they know where you are? iii. Voice communication? 1. Two-way? if so who with?
Emergency exits	When did you look for where the emergency exits are located? 1. As you entered? 2. When asked to tell me how we might leave in an emergency? 3. Other, what prompted you?
Emergency egress features	What emergency egress features/design have you noticed about this place?
Previous experience	Have you ever been in an incident or a drill that occurred in a place similar to this? 1. If you have: a. What did you first do? b. How long did it take to decide to move? What made you decide to move (e.g., annoying alarm sounder, other patrons moving, etc.)? c. Did you go out the way you had come in? Did you look for an emergency exit? d. What did you observe about other patrons? e. What did you observe about staff? Did staff give any directions? f. What worked and why? What didn't work and why? g. What would you do differently, if given the opportunity? h. Have you changed how you do things since having this experience? If so, what have you changed? 2. If you haven't: a. What do you think you might do? e.g., go to your car, get 'outside' as fast as possible, 'outside' = where you might feel safe? e.g., being able to see sky, etc.? b. How much of this is influenced by earlier discussions? i.e., did you find the discussion useful? How did you

	find it useful? What have you changed your mind about or added to what you were already thinking?

B.2 Scenario B: Mall

Scenario	B
Brief description	Mall (could also be applied to a library or museum, etc.)
General description of activities in this type of building	A number of small boutique shops A few larger department/supermarket type shops Food court Cinema [also see Scenario C for some specific cinema related aspects] Performance or display area
What might you be doing?	Who do you have with you? Are you together or in different parts of the shop or in different shops?
If an alarm was to sound	What prompts you to think that it is something that you should respond to? • The alarm noise • That other people respond • Seeing chaos (smoke, fire, etc.) What would prompt you to move to an exit? • The alarm noise • A voice notification over the building PA • Waiting for other people to move • A staff member telling you to evacuate the building • Other What will make you move in a direction? • Do you head back to your car or bus or how you got here? • Do you look for the nearest exit sign? • Do you go in the general direction that most people are heading? • Do you head for a particular thing or location in the building? • Would you ask people for information or help? If so, what would you ask them?
Previous experience	Have you ever been in an incident or a drill that occurred in mall? 1. If you have: a. What did you first do? b. How long did it take to decide to move? What made you decide to move (e.g., annoying alarm sounder, other patrons moving, etc.)? c. Did you go out the way you had come in? Did you look for an emergency exit? d. What did you observe about other patrons? e. What did you observe about staff? Did staff give any directions? f. What worked and why? What didn't work and why? g. What would you do differently, if given the opportunity? h. Have you changed how you do things since having this experience? If so, what have you changed? 2. If you haven't: a. What do you think you might do? e.g., go to your car, get 'outside' as fast as possible, 'outside' = where your might feel safe? e.g., being able to see sky, etc.?

APPENDIX C SUMMARY OF WORSHOP DESCRIPTIONS

C.1 Pilot Workshop Format – Example Outline

PROJECT CONTEXT

BRANZ

- Increasing urban density with more multi-use, multi-storey buildings
- Changing population profile, particularly given ageing, and a wider range of capabilities

OBJECTIVES

BRANZ

PROJECT

- Understand NZ population characteristics and trends and how buildings are used in emergency situations (now and in the future) to inform building design tools, guidelines, standards and regulations.

WORKSHOPS

- Collect experiences, ideas and information from different user groups about egress from current buildings.

POTENTIAL USER GROUPS

BRANZ

- Those with mobility/physical, hearing, sight, cognitive impairments
- The ageing –often under-estimating their impairment
- Those with medical/health- or situational-induced incapacities (e.g., broken leg, pregnancy, heart condition, parent with a pram or toddlers, mental health episode, etc.)

MODELS OF SAFE EGRESS

BRANZ

- Used in building design, evacuation plans, emergency management, etc.
- Take account of the nature and intended use of the building and the range of capabilities (abilities/disabilities) of building users.

Examples of user data

BRANZ

- Demographics
- Preferences/needs re self-rescue or refuge awaiting assistance
- Varying times taken to evacuate
  - cues seen/heard re nature of emergency
  - familiarity with building
  - geography of building
  - speed of walking/moving
  - likely route choice (avoidance of obstacles, etc)

Exercise 1

Let's imagine the building alarm going off now - while we are in this room.

- What would you first think is going on?
- What is the first thing you would do?
- What would prompt you to move - and where would you go?

- What route would you take? Is that the same as the way you came into this room and the building?
- What factors would you think about as you start to move?
- Would you ask for help? If so, what would you ask for and from whom?

Exercise 2

You are in a shopping mall. Think of the mall you are most familiar with - with a variety of smaller shops, a department store, supermarkets, cafes and a food court. You came by car with a family member and parked on the ground level.

You go up to a 2nd level café and have a coffee while your companion goes off to level 1. The building alarm goes off.

- What would you first think is going on?
- What is the first thing you would do?
- What would prompt you to move - and where would you go?
- What route would you take? Is that the same as the way you came in?
- What factors would you think about as you start to move?
- Would you ask for help? If so, what would you ask for and from whom?

POTENTIAL EGRESS FEATURES

- alarm
- strobe lights
- pre-recorded or live voice notification
- emergency lighting
- way finding aids - exit signs, arrows, maps
- trained staff
- areas of refuge
- hardened elevators
- stair assistance devices

YOUR IDEAS TO IMPROVE EGRESS

- Are special provisions needed?
- What other features could help?
- Are different measures needed for different sorts of buildings?
- How could we ensure these measures work for specific groups?
- Can you prioritise these measures?
- Are there still gaps?

C.1.1 Example Outline for Follow-Up Pilot Workshop

(Second Christchurch Pilot Workshop)

OBJECTIVES

BRANZ

PROJECT

- Understand NZ population characteristics and trends and how buildings are used in emergency situations (now and in the future) to inform building design tools, guidelines, standards and regulations.

WORKSHOPS

- Collect experiences, ideas and information from different user groups about egress from current buildings.

Preamble

BRANZ

- As we discussed last time, we are keen to hear your ideas about safety improvements in buildings for people with disabilities responding to an emergency.
- We are also interested in what has happened in the time between the workshop last year and this workshop three months later.

From first to this workshop ...

BRANZ

- What were the main messages for you that came out of the last workshop?
- Have you since changed anything that you do or think about related to your safety?
- What are those changes?

From first to this workshop ...

BRANZ

- Did you talk with anyone else about the workshop?
- What did you talk about?
- What was their reaction?
- Did they have any new ideas or perspectives?
- Has that given you further food for thought?

From first to this workshop

BRANZ

- What do you now look for when you go into a building?
- What sorts of things do you now know about for getting out in an emergency?
- Do you now know more than before?
- What ways would you now use? How would you get to that place or thing?
- What is missing from the building that would or might help you?

Examples of potential egress features:

Area of Refuge is a designated place within a building where people can gather for assisted rescue

- Would you know where it is?
- Would you use it?
- If not, why not?
- Would some changes or additions make you more comfortable using it?
- Or would you still never consider using it?

YOUR IDEAS TO IMPROVE EGRESS

Elevators

- Would you be comfortable using elevators in an emergency?
- If not, why not?
- What would you need to feel confident to use an elevator for egress?
- Or would you still never consider using it?

Evacuation chairs

- Would you be comfortable using an evacuation chair in an emergency.
- If not, why not?
- What would you need to feel confident about using an evacuation chair?
- What would you need to feel confident about the people operating the evacuation chair for you?

Other suggested egress features:

- Would you be comfortable using .... in an emergency?
- If not, why not?
- What would you need to feel confident to use a .... for egress?
- Or would you still never consider using it?

Education

Message targeting

- Should everyone be given the same message or information about accessible and safe emergency egress and how to help others?
- If there is to be targeting, then why, who, what and how?

Reaching children with safety messages

- How can children be best reached to teach them about accessible egress?
- Who is best placed to teach children?

Teaching the helpers

- How can potential helpers be better prepared or informed to meet your needs in getting out of a building in an emergency?
- What is the one thing that you would like a stranger (who could be a helper) to know?
- What is the most important messages that could become 'common knowledge' in our community?

APPENDIX D REGULATION AND GUIDANCE MAPPING OUTLINE

D.1 New Zealand Regulations, Standards and Guidance

D.1.1 Sources

Sources used in the examples of New Zealand egressibility-related requirements and guidelines are:

FSA. 1975. Fire Service Act, Section 21B. Government of New Zealand. Wellington, New Zealand.

NZBC. 1992. New Zealand Building Regulations 1992, Schedule 1, The Building Code, Objective D1 – Access Routes, Objective D1.1(c). Government of New Zealand. Wellington, New Zealand.

NZBR. 1992. New Zealand Building Regulations 1992, Schedule 1, The Building Code, Clause C4, Functional Requirement C4.2. Government of New Zealand. Wellington, New Zealand.

NZBR. 1992. New Zealand Building Regulations 1992, Schedule 1, The Building Code, Clause C4 – Movement to Place of Safety, Functional Requirement C4.2. Government of New Zealand. Wellington, New Zealand.

NZFS. 2014. Guide to Evacuation Schemes (December 2014). New Zealand Fire Service. Wellington, New Zealand.

NZFSA. 1975. New Zealand Fire Service Act, Section 21B(2). Government of New Zealand. Wellington, New Zealand.

NZFSR. 1992. New Zealand Fire Safety Regulations [now superseded by 2006 version]. Government of New Zealand. Wellington, New Zealand.

NZFSR. 2006. New Zealand Fire Safety and Evacuation of Buildings Regulations, Part 2 Evacuation schemes for buildings described in Section 21A(1) of Fire Service Act, Section 18 Matters to be included in evacuation scheme in relation to persons with disability. Government of New Zealand. Wellington, New Zealand.

NZS 4121. 2001. Design for Access and Mobility – Buildings and Associated Facilities. Standards New Zealand. Wellington, New Zealand.

NZS 4512. 1997. Fire alarm systems in buildings. Standards New Zealand. Wellington, New Zealand.

D.1.2 Summary of Requirements and Guidance

The following summary table is a list of extracts from the New Zealand sources listed above provided in the format of the mapping analysis that was presented in Section 2.1.3. The references are summarised at the end of the table for ease of reference.

Table 7: Summary of New Zealand egressibility-related Building Code requirements and guidance. (References are located at the end of the table).

Building Features	Example Components of Features	Summary of New Zealand Regulations, Requirements, Standards or Guidance
Alarm	General	[Table Ref 3] Paragraph 4.12 Alerting devices Fire alarm system shall have an audible and visual alerting device. [Table Ref 3] Paragraph 4.13 Audible and visual The audible and visual aspects of the alerting device shall comply with the

		requirements of NZS4512. [Table Ref 3] Paragraph 14.6.6 Alerting devices Alerting devices shall be provided on accessible routes and in accessible accommodation, refer to 4.12. Where the installation of an automatic fire alarm system is required, an alerting device shall be installed within every accessible accommodation unit. In all cases this alerting device shall be located within the unit in a position clearly visible from the bed or beds and have an audible and visible signal.
	Sounder	[Table Ref 3] Paragraph 4.13 Audible and visual The audible and visual aspects of the alerting device shall comply with the requirements of NZS4512. [Table Ref 3] Paragraph 14.6.6 Alerting devices Alerting devices shall be provided on accessible routes and in accessible accommodation, refer to 4.12. Where the installation of an automatic fire alarm system is required, an alerting device shall be installed within every accessible accommodation unit. In all cases this alerting device shall be located within the unit in a position clearly visible from the bed or beds and have an audible and visible signal.
	Visual	[Table Ref 3] Paragraph 4.13 Audible and visual The audible and visual aspects of the alerting device shall comply with the requirements of NZS4512. [Table Ref 3] Paragraph 14.6.6 Alerting devices Alerting devices shall be provided on accessible routes and in accessible accommodation, refer to 4.12. Where the installation of an automatic fire alarm system is required, an alerting device shall be installed within every accessible accommodation unit. In all cases this alerting device shall be located within the unit in a position clearly visible from the bed or beds and have an audible and visible signal.
Wayfinding		[Table Ref 3] Paragraph 4.5.4.2 Egress The nominated 'means of escape' route shall be clearly indicated at the turnstile or trolley trap so that people with disabilities do not attempt to use the turnstile or trolley trap in an emergency.
Egress routes	Surface continuity	[Table Ref 3] Paragraph 4.5.4.2 Egress The nominated 'means of escape' route shall be clearly indicated at the turnstile or trolley trap so that people with disabilities do not attempt to use the turnstile or trolley trap in an emergency.
	Door opening force	[Table Ref 4] Paragraph 7.3.6 Fire and smoke control doors The force necessary to keep them shut and so be effective in a fire may not be easily overcome by people with disabilities. Studies suggest that a force of 70 N could be handled by up to 80% of the people with disabilities and a force of 21 N could be handled by 95% of the people with disabilities. In a pressurised situation the use of barometric relief dampers or other pressure regulating methods may be required. Wherever possible considerations should be given to the installation of complying hold open devices. Note: Table 1 of BS/EN 1154:1996 identifies seven power sizes of door closer with various forces. Table 1 applies to interior doors under ideal conditions so the door closer should be adjusted to a higher power setting where it is used as an exterior door and in windy or draughty interior conditions. For exterior doors, adjustable power sizes 2-6 and for interior doors, adjustable powers sizes 1-5 are recommended. Attention to the manufacturer's instructions is vital where installing door closers. Ongoing maintenance is necessary to adjust and maintain the required forces for both closing and latching a door. There is a 'push-pull' device available to installers and building owners for measuring door closer forces. NOTE: Paragraph 7.3.5. Forces required The force required to push or pull open a non-fire door shall not exceed the following: a) Exterior hinged door: 38 N; b) Interior hinged door: 22N; c) Sliding or folding doors: 22N.

	Stair specifications (forming part of an exit)	[Table Ref 3] Paragraph 8.3.4 Encroachment into corridors The top or bottom step of any flight of stairs shall not encroach into corridors so that the effective minimum width of the corridor on accessible route or means of escape in fire is compromised. Where stairs do encroach, they shall be protected by a barrier or a return wall indicated by a change in surface texture of the floor. [Table Ref 3] Paragraph 8.3.6 Landings for stairs 8.3.6.1 Landing lengths of at least 1200 mm (including mid-flight landings, where on a straight or zigzag set of stairs) are required to ensure that wheelchair users may be safely carried down (up) stairs in their own wheel chairs in an emergency, (generally the preferred evacuation method). This length ensures both a safe resting place for the wheelchair user and enables other people to pass safely.
Stay in place/wait for assistance	Areas of refuge	[Table Ref 1] The New Zealand Regulations require all evacuation schemes to have the following for persons with disabilities who may be unable to evacuate: place(s) inside the building where persons with disabilities may wait for assistance during an evacuation. [Table Ref 2, Q3.7, p19] The New Zealand Regulations require all evacuation schemes to have the following for persons with disabilities who may be unable to evacuate: place(s) inside the building where persons with disabilities may wait for assistance during an evacuation. This place can be any nominated space inside the building (for example stairwell, reception), but does not need to be a place of safety inside. This is a requirement for all evacuation schemes, even if there are not any permanent occupants who are persons with a disability. There should be an adequate number of nominated places for persons with disabilities to gather for the use and occupancy of the building. This may mean that for a multi-storey building there should be a number of places in the building for persons with disabilities to gather (for example, in the stairwell on each level). [Table Ref 3] Paragraph 8.3.6 Landings for stairs 8.3.6.1 Landing lengths of at least 1200 mm (including mid-flight landings, where on a straight or zigzag set of stairs) are required to ensure that wheelchair users may be safely carried down (up) stairs in their own wheel chairs in an emergency, (generally the preferred evacuation method). This length ensures both a safe resting place for the wheelchair user and enables other people to pass safely.
	Rescue provisions	[Table Ref 1] Paragraph 8.3.6 Landings for stairs 8.3.6.1 Landing lengths of at least 1200 mm (including mid-flight landings, where on a straight or zigzag set of stairs) are required to ensure that wheelchair users may be safely carried down (up) stairs in their own wheel chairs in an emergency, (generally the preferred evacuation method). This length ensures both a safe resting place for the wheelchair user and enables other people to pass safely.
Evacuation scheme/ Fire safety plan		[Table Ref 1, sections 21A and 21B(2) the Act] A relevant building is a building that is used for one or more of the following purposes: - the gathering together, for any purpose, of 100 or more persons - providing employment facilities for 10 or more persons* - providing accommodation for more than 5 persons (other than 3 or fewer household units)* - a place where hazardous substances are present in quantities exceeding the prescribed minimum amounts (see Appendix B for a list of these amounts), whatever the purpose for which the building is used - providing early childhood facilities (other than in a household unit) - providing nursing, medical, or geriatric care (other than in a household unit) - providing specialised care for persons with disabilities (other than in a household unit) - providing accommodation for persons under lawful detention (other than home detention, community detention, or parole). *If the building is used for either (but not both) of these two purposes, and has an automatic sprinkler system (as described in Regulation 16), refer to the section below 'Notice to the National Commander that an evacuation scheme is not required'. [Table Ref 2, p4] The owner of a relevant building is not required to submit an

		application for approval of an evacuation scheme to the Fire Service if the building: * has an automatic sprinkler system AND * is used for EITHER: – providing employment facilities for 10 or more persons, OR – providing accommodation for more than 5 persons (other than 3 or fewer household units) The building must have an automatic sprinkler system and be used for either (but not both) of the two purposes above to fall within this provision. [Table Ref 3] Paragraph 8.3.6 Landings for stairs 8.3.6.1 Landing lengths of at least 1200 mm (including mid-flight landings, where on a straight or zigzag set of stairs) are required to ensure that wheelchair users may be safely carried down (up) stairs in their own wheel chairs in an emergency, (generally the preferred evacuation method). This length ensures both a safe resting place for the wheelchair user and enables other people to pass safely.
	Listing of evacuation equipment, if provided	[Table Ref 2, Q3.8, p19] This question covers equipment in the building (if any) including: • evacuation chairs • hoists • wheelchairs • stretchers • mobile cots. This question does not include things like access ramps.
	Evacuation training programme	[Table Ref 1, Clause 5 of Schedule 3 of the Regulations] This is a statement that the evacuation training programme will be carried out in accordance with clauses 5 to 7 of Schedule 3 of the Regulations. The evacuation training programme must be carried out at least every six months. [Table Ref 2, Q4.8, p21] The evacuation training programme must include details about how permanent occupants are trained and assessed including: * frequency of training * how occupants are alerted to a fire in the building * how occupants are informed of: – the measures they should take for their personal safety once alerted to a fire – the need (if necessary) to evacuate to the place(s) of safety – where the place(s) of safety are and the fastest way to get to them * use of firefighting equipment (if any) in the building * use of equipment (if any) for assisting persons with disabilities to evacuate.
Definitions	Persons with a disability	[Regulation 3(1) of Table Ref 1] (a) a person: (i) who has an impairment or a combination of impairments that limits the extent to which the person can engage in the activities, pursuits, and processes of everyday life, including, without limitation, any of the following: (A) a physical, sensory, neurological, or intellectual impairment: (B) a mental illness; and (ii) who is unable to sense or understand a fire alarm or leave a building, during a fire emergency, in a way that a person without the same disability would be capable of doing; and (iii) includes any person who considers that he or she would be unable to leave a building during a fire emergency by using its means of escape from fire.

Table 7 References:

1. New Zealand Fire Safety and Evacuation of Buildings Regulations. 2006. Part 2, Section 21A(1) of Act, Section 18.
2. New Zealand Fire Safety Guide to Evacuation Schemes. December 2014. New Zealand Fire Service, Wellington, New Zealand.
3. NZS4121. 2001. Design for Access and Mobility – Buildings and Associated Facilities, Standards New Zealand. Wellington, New Zealand.

D.2 Selected International Regulations, Standards and Guidance

D.2.1 Sources

ADAAG. 2010. American Disability Association Accessibility Guidelines for Buildings and Facilities. United States Access Board. Washington, DC, USA.

AHRC. 2008. Access to Buildings and Services: Guidelines and Information. Australian Human Rights Commission. Sydney, Australia.

AHRC. 2013. Guideline on the Application of the Premises Standards, Version 2, February 2013. Australian Human Rights Commission. Sydney, Australia.

AS1428.1. 2001. Design for Access and Mobility – General requirements for access – New building work. Standards Australia. Sydney, Australia.

AS1428.2. 1992. Design for access and mobility – Enhanced and additional requirements – Buildings and facilities. Standards Australia. Sydney, Australia.

AS1428.3. 1992. Design for access and mobility – Requirements for children and adolescents with physical disabilities. Standards Australia. Sydney, Australia.

AS/NZS1428.4. 2002. Design for access and mobility – Tactile indicators. Standards Australia. Sydney, Australia.

FRLI. 2010. Australian Government Disability Access to Premises, Buildings Standard. Schedule 1, Part D. Federal Register of Legislative Instruments F2010L00668.

IBC. 2012. International Building Code. International Code Council. Washington, DC, USA.

ICC A117.1. 2009. Accessible and Usable Buildings and Facilities. American National Standard, New York, NY, USA. International Code Council, Washington, DC, USA.

NFPA 101. 2015. Life Safety Code®. National Fire Protection Association. Quincy, MA, USA.

NFPA 72. 2013. National Fire Alarm Signaling Code. National Fire Protection Association. Quincy, MA, USA.

NFPA. 2007. Emergency Evacuation Planning Guide for People with Disabilities. National Fire Protection Association. Quincy, MA, USA.

D.2.2 Summary of Requirements and Guidance

The following summary table is a list of extracts from selected international sources listed above provided in the format of the mapping analysis that was presented in Section 2.1.3.

Table 8: Summary of selected international egressibility-related Building Code requirements and guidance.

Building Features	Example Components of Features	Descriptions of Elements of Components	
Alarm	General		Fire emergency warning systems, signals and information are to be communicated simultaneously by sounder, light strobe, voice message and individual tactile sensation by vibration. (ISO21542 2011, Section 34) Consideration is required of room layouts, lighting levels and furniture arrangements to ensure that these alarms are visible. A strobe frequency of 2-4 hertz will minimise the risk of triggering a reaction from a person with epilepsy and overlapping of strobes are not to occur to result in a higher frequency of flashing. Vibrating devices such as pagers or mobile phones can be integrated with alarm systems to provide an individual alarm. Principle of two senses is to be applied in designing supportive measures for information and wayfinding in a format that is accessible to people with sensory impairments according to the principle of two senses. (ISO21542 2011, Section 39.2) A notification appliance is “a fire alarm system component such as a bell, horn, speaker, light, or text display that provides audible, tactile, or visible outputs, or any combination thereof”. (ISO21542 2011, Section 39.2) Additional information is also included in the references: NFPA72; BS8300, 2009; ANSI-A117.1, 2009, Section 702.
	Sounder		Acoustic warning systems are to utilise a larger number of sounders between 85 dB-95 dB with low output. Whereas a small number of sounders with high output would lead to confusion and disorientation among building users. (ISO21542 2011, Section 34.3) It is also noted that children under ten years of age, who are asleep, are more difficult to wake than adults. (ISO21542 2011, Section 34.3) The acoustic environment in a building is to be suitable for its intended function for all building users, including all hearing people especially the hard of hearing. People with some degree of hearing loss may have assistive devices to amplify sound, such as hearing aids or cochlear implants and the acoustic environment is to be designed to be supportive of these devices. People who have a mild or temporary hearing loss and do not have assistive devices, may not be able to access information or communicate effectively. (ISO21542 2011, Section 32.1) For deaf and hard-of-hearing people good lighting is essential to understand the sign language interpreter and/or optical information devices. People with hearing loss and people without hearing loss may rely on sight to lip read or interpret facial expressions. (ISO21542 2011, Section 32.1) Colour and visual contrast is to be designed to benefit all building users. (ISO21542 2011, Section 32.1)

			Information normally conveyed in visual form may not be accessible to people with a sight impairment. This information is to be also conveyed audibly. (ISO21542 2011, Section 32.1) Additional information is also included in the references: ANSI A117.1 (2009) Section 702.1, and NFPA 72.
	Visual		Light strobes/beacons are to be clearly visible and installed throughout the building including locations within buildings where people are apt to be alone (e.g., washrooms) and also in noisy environments (ISO 21542 2011, Section 34.2). If strobe lights are present in a building, communication to entering building occupants is required. (ISO 21542 2011, Annex E) A larger number of strobes/beacons with low output is to be specified. A small number of strobes/beacons with high output is not to be used, as these produce glare causing confusion and disorientation among building users. (ISO 21542 2011, Section 34.2) Light strobes/beacons – always ensure a slow rate of flash (e.g., once every two seconds) in order to avoid epileptic seizures. Most importantly, the flash of one strobe/beacon should be synchronised with the flashes of all other light strobes/beacons in view. Universally-accepted pictograms are to be used in preference to text. See ISO 7000, ISO 7001, ISO 7010, ISO 16069 and ISO 28564-1. (ISO21542 2011, Section 39.4) Additional information is also included in the references: ANSI-A117.1 (2009), Section 701.1, and NFPA 72.
	Shaker		Additional information is also included in the references: ANSI-A117.1 (2009) Section 701.1, and NFPA 72.
	Pre-recorded voice notification		Voice messages – a short message should contain appropriate warning information which is easily assimilated. It is suggested that the speaker should be distinct and easy to understand. Furthermore, messages should be provided in at least two different languages. (ISO 21542 2011, Sections 34.3, 39.4)
Wayfinding	General		Directions to and through the usable circulation path include signage, oral instructions passed from person to person and instructions, which may be live or automated, broadcast over a public address system. (NFPA 2007) Recent technological advances in personal notification devices provide potential information transfer in a number of ways, including but not limited to having a building's alarm system relay information to the device. The information can be displayed in a number of forms and outputs. Because this technology is new to the market, there is little guidance. However, it is suggested that emergency evacuation personnel and people with disabilities may want to investigate these options further. (NFPA, 2007) Universally-accepted pictograms are to be used in preference to text. See ISO 7000, ISO 7001, ISO 7010, ISO 16069 and ISO 28564-1. (ISO21542 2011, Section 39.4)
	Signage – exits, directions, schematic floor schemes		In order to facilitate orientation and to ensure safe use of an environment, adjacent surfaces, information and potential hazards shall provide a discernible visual contrast including light reflectance values (LRVs). The perception of visual contrast increases with better lighting conditions. Therefore for lower lighting conditions, the difference in LRVs should be higher. Reflections and glare from shiny surfaces may reduce visual contrast and may confuse people with vision impairments. Deterioration and maintenance shall be considered at installation. (ISO21542 2011, Section 35) Stairwells should have information signs identifying all points of

			entry and exit. Floor numbers shall be located on each floor at top and bottom of stairs, on handrails and on each side of the outer frame of each lift car entrance on each floor and prominently displayed elsewhere so they are visible from the lift car at each level. (ISO 21542 2011, Section 40.2) Directional and functional signs should be located below 1600 mm where they are easy to approach, to touch and read the raised elements with the fingers. (ISO 21542 2011, Section 40.4) Communication systems are to be placed on the latch side and preferably in a range of 1000 mm-1200 mm above ground level. (ISO 21542 2011, Section 40.2) Font style should be a sans serif font similar to Helvetica or Arial medium. The letter height depends on the reading distance. (ISO 21542 2011, Section 40.5) Minimum difference in LRVs for small targets, like signs and inscriptions, to signboards, are to be 60 points. (ISO 21542 2011, Section 40.6) Signs are to be glare-free when mounted. (ISO 21542 2011, Section 40.7), well illuminated with no glare (ISO 21542 2011, Section 40.8). Signage requirements are also provided in ICC A117.1 for visual characters and include the International Symbol of Accessibility (IBC 2012, Section 1011.4). ANSI A117.1 (2009), Section 703 also provides other requirements. Signs are to be readable and legible for people who have vision or mental impairments. Well-illuminated, clear and readable signs are to be placed at a consistent height. Information with text is to be supplemented with graphical symbols to facilitate comprehension for everyone. Signs are to be provided in relief and Braille. (Further guidance for wayfinding and signing is included in ISO 16069 and ISO 28564-1). (ISO 21542 2011, Section 40) Signs are to be readily understandable, designed so as to be simple and easy to interpret, and the message is to be unambiguous. Short sentences and simple words are to be used. Abbreviations and very long words are hard to understand and should be avoided. (ISO 21542 2011, Section 40.9) Tactile symbols applied on handrails, doors, maps or floor plans shall have a raised relief contour similar to tactile letters. (ISO 21542 2011, Section 40.13) Only essential information is to be included on a tactile map or floor plan. The map is to be orientated with the building. (ISO 21542 2011, Section 40.14) Signage indicating special accessibility provisions to areas of refuge and exterior areas for assisted rescue is to be provided (IBC 2012, Section 1007.9). Additionally, raised character and Braille signage complying with ICC A117.1 is to be located at each door to an area of refuge and exterior area for assisted rescue. (IBC 2012, Section 1011.4) Direction signage indicating the location of the other, accessible means of egress are to be provided at the following (IBC, 2012, Section 1007.10): 1. At exits serving a required accessible space but not providing an approved accessible means of egress. 2. At elevator landings. 3. Within areas of refuge. In areas of refuge and exterior areas for assisted rescue, instructions on the use of the area under emergency conditions are to be posted. The instructions are to include all of the following (IBC, 2012, Section 1007.11): 1. Persons able to use the exit stairway do so as soon as possible, unless they are assisting others.

			2. Information on planned availability of assistance in the use of stairs or supervised operation of elevators and how to summon such assistance. 3. Directions for use of the two-way communications system where provided.
		Colours and patterns	Information on requirements for colours and patterns (ISO 21542 2011, Section 35.2) and visual contrast (ISO 21542 2011, Annex B.7) and design factors (ANSI A117.1, 2009, Section 703.2.10) are included in the context of providing interpretable information for people with vision impairments.
		Words	Information on requirements for font and size of lettering (ISO 21542:2011, Section 40.5; and ANSI A117.1, 2009, Section 703.2.4) and interpretation (ISO 21542:2011, Section 40.9).
		Symbols	Information on the requirements of the use of graphical symbols (ISO 21542:2011, Section 41), listings of the standards for graphical symbols (ISO 7000, ISO 7001 and ISO 7010), tactile graphical symbols on directional and door signs, the height, size and location for viewability, and for pictograms to be accompanied by text descriptors located directly below the pictogram field (ANSI A117.1 2009, Section 703.1.3).
		Tactile signs	Information on the requirements of the heights of tactile letters, figures, signs and graphical symbols (ISO 21542 2011, Section 40.11 to 40.14) and inclusion of both raised characters and Braille (ANSI A117.1 2009, Section 703.1).
		Tactile maps & floor plans	Information on the requirements of the provision of tactile maps and floor plans (ISO 21542 2011, Section 40.14) for the level of information and the orientation with the building.
		Reflective	Information on the requirements of differences in light reflectance values (LRVs) (ISO 21542 2011, Section 40.6 and Annex B.7) and what colours to avoid the use of because of difficulties in contrast perception.
		Backlit	Information on the requirements for visual contrast (ISO 21542 2011, Annex B.7).
		Photoluminescent	Information on the requirements for visual contrast (ISO 21542 2011, Annex B.7).
		Tactile walking surface	Information on the requirements for tactile walking surface indicators (TWSIs) (ISO 21542 2011, Annex A, and ADAPBS Guideline 2013, page 91), types of surfaces and the meanings (attention/warning and guiding indicators), installation, application, detection, visual contrast, trip hazard and dome or rib design requirements.
		Identification of doors	Information on the requirements for relevant door design factors for visual contrast (ISO 21542 2011, Annex B.7.3), opening direction and signage (ANSI A117.1 2009, Section 703.3.11).
	Trained staff tasks		Information on the requirements for providing assisted fire evacuation (ISO 21542 2011, Section 38.3) such that the building features are intended to support successful evacuation and every occupant, whatever his or her abilities, should be able to evacuate independently to the maximum degree possible, independent evacuation may not be possible for all occupants. For those occupants who need assisted evacuation, a strategy for this provision is required for the specific building and there may need to be areas of rescue assistance.
	NOT A BUILDING FEATURE		Information on the requirements for providing continuity and components of each required accessible means of egress (IBC 2012, Section 1007.2) including requirements for the accessible route, interior exit stairways, interior exit access stairways, exterior exit stairways, elevators, platform lifts, horizontal exits, ramps, areas of refuge, and exterior area for assisted rescue.
Egress routes	General		Information on the requirements for internal passages minimum unobstructed widths of 1200 mm, where 1800 mm is preferred (ISO 21542 2011, Section 11), and exceptional considerations for existing buildings, obstructions, turning space (ISO 21542 2011, Section 11.3 and 11.4), vertical circulation (ISO 21542 2011, Section 12), ramps (ISO 21542 2011, Section 12.2), and stairs

			(ISO 21542 2011, Section 13) including minimum width, landing sizes, provision for contra flow, head clearance, visual and tactile warnings, and guards. Other exit requirements are provided in ADAPBS (2011), Sections DP4 and DP6.
	Corridor/aisle clearances		Information on the requirements for internal passages minimum unobstructed width of corridors of 1200 mm, with a preference for a width of 1800 mm (ISO 21542 2011, Section 11.2), with exceptional considerations for existing buildings in developing countries, a minimum clear height of 2100 mm and consideration of directionality of single or contra directional flows, clearance of hanging objects on walls, turning space and general design considerations for wheelchair users (ISO 21542 2011, Annex B.6) including clearances, reach range and reachability, and viewability.
	Surface continuity		Information on the requirements for floor and wall surface coverings, acoustic performance and visual contrast (ISO 21542 2011, Section 31).
	Door clearances		Information on the requirements for doors and door furniture for fire-resisting doorsets (ISO 21542 2011, Section 18.2) and general door requirements (ISO 21542 2011, Section 18.1) including minimum unobstructed width, maximum operating force. When the operating force needed to open the door is greater than 25 N, an automatic opening door is recommended, visual contrast, identification (ISO 21542 2011, Section 10) floor level and threshold design, and circulation space at doorways (ISO 21542 2011, Annex C).
	Door operation	Manual, lever, button call, closer operation	
	Door opening force		Information on the requirements for door operating force (ISO 21542 2011, Section 18.1.4).
	Door swing		Information on the requirements for door unobstructed manoeuvring space (ISO 21542:2011, Section 10.8.2 and Annex C).
	Door swing clearances		Information on the requirements for door unobstructed manoeuvring space (ISO 21542:2011, Section 10.8.2 and Annex C).
	Ramp specifications (forming part of an exit)		Information on the requirements for ramps (ISO 21542 2011, Section 8 and Section 12; and ADAPBS Guideline 2013, page 79) design details, handrails, maximum floor height change without a flight, width between handrails, slope and length, maximum slope and length and exceptional considerations for existing buildings, landing size and tactile indicators.
	Stair specifications (forming part of an exit)		Information on the requirements for stairs (ISO 21542 2011, Section 12 and Section 13; and IBC 2012, Section 1007.3) for rise and run of steps, minimum width, landing size, head clearance, visual and tactile warnings, and guards.
	Elevator specifications (forming part of an exit)		Information on the requirements for elevators for fire evacuation (ISO 21542 2011, Section 15.6 and Annex D.3). If lifts/elevators in existing buildings undergo a major overhaul or if they are replaced, they should be made capable of use for this purpose. It is noted that requirements for lift cars being used for evacuation are a matter of national building regulation. Firefighting elevators might be used for the evacuation of building users up until the time that firefighters arrive at the building and take control of the elevators. Pre-planning is always necessary with local fire authorities to agree suitable procedures with regard to this use of the elevators. All elevators used for evacuation should be easily accessible and clearly identifiable. The controls for the elevators shall be located in the areas where users must wait and these areas shall be

			designed to ensure a tenable environment provided at all times while evacuation is taking place. Elevators should not be used for evacuation unless built for this purpose and suitably protected by the building design. The location of elevators in a building, preferably outside a central position on the floorplan, is to be considered in relation to the supporting fire evacuation staircases, areas of rescue assistance and direct protected access to final fire exits leading to places of safety. An elevator to be used for the fire evacuation of people with activity limitations and/or with impaired senses is to be operated under the strict direction and control of a building's management. IBC requires that in order to be considered part of an accessible means of egress, an elevator shall comply with the emergency operation and signaling device requirements of Section 2.27 of ASME A17.1. (IBC 2012, Section 1007.4). The elevator is to be accessed from either an area of refuge or a horizontal exit, except in open parking garages or in buildings sprinklered throughout.
	Platform lift specification (forming part of an exit)		Platform (wheelchair) lifts are not to serve as part of an accessible means of egress, except where allowed as part of a required accessible route in Section 1109.7, Items 1 through 9 (IBC, 2012, Section 1007.5).
	Escalators and travellators (forming part of an exit)		It is acknowledged in ISO 21542 (2011) Section 17 that escalators and moving walks are very common in public buildings and greatly facilitate circulation of occupants, however, it is noted that no ISO standard is available for escalators and moving walks. CEN/TC 10 has published EN 115-1 which is a harmonised standard for European Member States and is also internationally accepted. Inclined moving walks are to comply with the requirements for ramps in buildings, warning notices and indicators shall be provided at the top and bottom of escalators where step rises reduce suddenly and dramatically when not operational. It is noted that elevators are the preferred method of vertical travel for most people with disabilities and in particular wheelchair users and persons with assistance dogs. Furthermore persons with a wheelchair generally cannot use horizontal travellators. An inclination up to 6 degrees will exclude a majority of wheelchair users from using a horizontal travellator independently.
	Assistance devices		Emerging fire evacuation technologies are noted they could include (ISO 21542 2011, Section 38.5): • intelligent evacuation management systems; • directional sounders for locating fire exits on each floor of a building which may be obscured by smoke.
		Stair assistance device (e.g., evacuation chair, rescue chair, stair sled, staircase stair, stair stretcher, flat/pole stretcher, soft/frameless stretcher, etc.)	Evacuation chairs are to be capable of (ISO 21542 2011, Section 38.4): • being safely and easily operated; • carrying people of large weight (up to 150 kg); • going up and down staircases; • travelling long distances horizontally and externally; and • compensating for any challenging features of a particular environment, such as narrow or unusually-shaped staircases or evacuation paths over rough ground.
Stay in place/wait for assistance	Areas of refuge		It is essential that movement to and from each area of rescue assistance does not encroach on the evacuation travel space of the staircase. Door leaves should also not open into or over this space. It is further noted that there may be competition between staircase evacuees and people using the area of rescue assistance that may work to reduce the ability to achieve different objectives if the evacuation travel space of the staircase overlaps

			the space used for movement to and from an area of rescue assistance. (ISO 21542:2011, Section 38.3.2) Fire evacuation routes, including all areas of rescue assistance, are to be kept clear at all times. An area of rescue assistance should be of sufficient size to cope with expected needs in a fire emergency. For example, if there are only two evacuation staircases on a floor in a building (on opposite sides), each area of rescue assistance should be designed to cater for the expected needs of the full floor. An area of rescue assistance in a building is to (ISO 21542:2011, Section 38.3.2): • be provided on every floor of a building, • adjoin every evacuation staircase, • include space for persons in wheelchairs, • have good lighting and be clearly indicated with good signage, • be fitted with an accessible and reliable independent communication system fitted at a height of 800 mm • be 1100 mm above floor level, facilitating direct contact with a person in the designated control room for the building, • be of sufficient size for the storage of an evacuation chair and a manual fire alarm call point, a fire evacuation supply kit containing, for example, smoke hoods, suitable gloves to protect a person's hands from debris when pushing his/her manual wheelchair, etc. It is noted that many commercially-available smoke hoods are advertised to provide protection from more fire effects than they actually do provide. • be marked with good signage Communication systems at areas of rescue assistance should provide visual feedback to people with hearing impairments that their location has been noted. The control point for the communication systems should be of a robust design to avoid risk of confusion about the location of building users. Where a signal board is used, this should be engraved or otherwise permanently marked to identify the particular building location and should not rely on sticky labels or translation tables. An area of refuge serves as a temporary haven from the effects of a fire or other emergency. The person with disabilities must have the ability to travel from the area of refuge to the public way, although such travel might depend on the assistance of others. If elevation differences are involved, an elevator or other evacuation device might be used, or the person might be moved by other people using a cradle carry, a swing (seat) carry, an in-chair carry or by a stair descent device. (NFPA, 2007) Two-way communications (NFPA 101, Life Safety Code, Section 7.2.12; and IBC 2009, Section 1007.8.1) are to provide communication between each required location and the fire command centre or central control point location approved by the fire department. Where the central control point is not constantly attended, a two-way communication system is to have a timed automatic telephone dial-out capability to a monitoring location or 911. The two-way communication system is to include both audible and visible signals. It is noted that most local authorities require two way off-site person-to-person voice communications. Areas of refuge are to be provided with a two-way communication system (IBC 2012, Section 1007.6.3), signage to the area of refuge (IBC 2012, Section 1007.9), directional signage within the area of refuge to the nearest accessible egress route (IBC 2012,

			Section 1007.10) and instructions within the area of refuge (IBC 2012, Section 1007.11). Every required area of refuge shall be accessible from the space it serves by an accessible means of egress (IBC 2012, Section 1007.6), the maximum travel distance from any accessible space to an area of refuge shall not exceed the travel distance permitted for the occupancy and every required area of refuge is to have direct access to a stairway or an elevator. Where an elevator lobby is used as an area of refuge, the shaft and lobby are to be smokeproof enclosures except where the elevators are in an area of refuge formed by a horizontal exit or smoke barrier. The area of refuge must be equipped with a two-way communication system with both visual and audible signals (ADAAG 2010). The Area of Refuge is to have adequate signage that directs the occupants to the area. The ADA guidelines apply to new buildings and significant remodels for public accommodations and commercial facilities with storeys above or below the main ground floor. Audible signals can include voice output or recorded messages. A button that lights to indicate that help is on its way is an acceptable visual signal. Each area of refuge is to be provided with a two-way communication system between it and a central control point (NFPA 72 2013, Section 24) and be identified by a sign stating "AREA OF REFUGE" displaying the international symbol of accessibility. Signs are to be installed at all exits not providing accessible means of egress and where otherwise necessary to clearly indicate the direction of the area of refuge (NFPA 101, Section 7.2), and instructions for the use of the two-way communications system and for summoning assistance via the two-way communications system in written identification, including Braille, of the location are to be posted adjacent to the two-way communications system.
	Exterior area for assisted rescue		Exterior areas for assisted rescue are to be accessed by an accessible route from the area served (IBC 2012, Section 1007.7). An exterior area of assisted rescue is to be provided at the exterior landings where the exit discharge does not include an accessible route from an exit located on a level of exit discharge to a public way (IBC 2012, Section 1007.7.1). An exterior area of assisted rescue is permitted as an alternative to an area of refuge (IBC, 2012, Section 1007.7.2). Requirements include a minimum fire-resistance rating of 1 hour for exterior walls separating the exterior areas for assisted rescue and the interior of the building, extending horizontally 3048 mm beyond either side of the landing. (IBC, 2012, Section 1007.7.4) The open sides of the exterior area for assisted rescue are to be at least 50 percent open and the open area is to be distributed to minimise the accumulation of smoke or toxic gases. (IBC, 2012, Section 1007.7.5) If the building is not sprinklered throughout, stairways that are part of the means of egress for the exterior area for assisted rescue shall provide a clear width of 1219 mm between handrails. (IBC, 2012, Section 1007.7.6) In areas of refuge and exterior areas for assisted rescue, instructions on the use of the area under emergency conditions are to be posted, including all of the following (IBC 2012, Section 1007.7.11): • Persons able to use the exit stairway are to do so as soon as possible, unless they are assisting others. • Information on planned availability of assistance in the use of stairs or supervised operation of elevators and how to summon such assistance.

			• Directions for use of the two-way communications system, where provided.
	Signage for areas of refuge		Instructions for the use of the two-way communication system to summon assistance and written identification of the location is to be posted adjacent to the two-way communication system. (IBC, 2009, Section 1007.8.2) Signage indicating special accessibility provisions is to be provided to show (IBC 2009, Section 1007.9) each door providing access to an area of refuge, identified by a sign stating: AREA OF REFUGE. Directional signage indicating the location of the other means of egress and which are accessible means of egress shall be provided at the following (IBC 2009, Section 1007.10): • At exits serving a required accessible space but not providing an approved accessible means of egress • At elevator landings • Within areas of refuge In areas of refuge and exterior areas for assisted rescue, instructions on the use of the area under emergency conditions are to be posted, including (IBC 2009, Section 1007.11): • Persons able to use the exit stairway do so as soon as possible, unless they are assisting others. • Information on planned availability of assistance in the use of stairs or supervised operation of elevators and how to summon such assistance. • Directions for use of the two-way communications system where provided.
	2-way voice communication systems		A two-way communication system is to be provided to a central control point or a constantly-attended monitoring location (NFPA 72, 2013, Section 24.5.3.3) at the elevator landing on each accessible floor that is one or more storeys above or below the storey of exit discharge, except two-way communication systems are not required (IBC 2009, 2012, Section 1007.8): • at the elevator landing where the two-way communication system is provided within areas of refuge (e.g., stairwell, areas of refuge) • on floors provided with ramps for egress. The area of refuge station is to be provided with hands-free, two-way communication that provides an audible and visible signal to indicate communication has occurred and indicate to the receiver the location sending the signal. (NFPA 72, 2013, Section 24.5.3.6) Instructions for the use of the two-way communications system and for summoning assistance via the two-way communications system is to be provided with written identification, including Braille and posted adjacent to the two-way communications system. (NFPA 72, 2013, Section 24.5.3.7) Additional information is also provided in ANSI A117.1 (2009) Section 708, and NFPA 72 (2013) Section 24.5.3.2.
	Evacuation equipment		Evacuation chairs are to be capable of (ISO 21542:2011, Section 38.4): • being safely and easily operated; • carrying people of large weight (up to 150 kg); • going up and down staircases; • travelling long distances horizontally and externally; and • compensating for any challenging features of a particular environment, such as narrow or unusually-shaped staircases or evacuation paths over rough ground. Emerging fire evacuation technologies may include (ISO 21542:2011, Section 38.4): • intelligent evacuation management systems;

			• directional sounders for locating fire exits on each floor of a building which may be obscured by smoke. The FEMA (2002) Orientation Manual shows and describes a wide range of assisted evacuation and rescue techniques for people with differing ranges of activity limitation. It is noted in ISO 21542 (2011) Annex D.2 that even with adequate training for everyone directly and indirectly involved, manual handling of wheelchairs occupied by their users is hazardous for the person in the wheelchair and those people giving assistance
	Rescue provisions		Extract from ISO 21542 (2011) Annex D.2: “Assisted evacuation and rescue from buildings. Rescue techniques Firefighters have two principal functions: a) rescuing people who are trapped in buildings, or for some reason, cannot independently evacuate a building which is on fire and b) fighting fires. People with disabilities are participating more and more, and in ever increasing numbers, in mainstream society. It is recommended that firefighters should receive training in how best to rescue a person with a disability from a building, using procedures and equipment which should not cause further harm or injury to that person. NOTE The 2002 FEMA (USA) Orientation Manual (see Bibliography) shows and describes many assisted evacuation and rescue techniques for people with widely differing ranges of activity limitation. Local fire authorities should ensure that they possess the necessary equipment to rescue people with a wide range of impairments, and that specialized rescue equipment is regularly serviced and maintained. Every fire authority should have an ‘accessible’ and ‘reliable’ emergency call system which is available at all times to the public. It is essential that every firefighter is fully aware of this important public safety issue and is regularly trained in the necessary rescue procedures involving people with a wide range of impairments.”
Evacuation scheme/fire safety plan	General		A fire defence plan comprises of fire engineering drawings, descriptive text, fire safety-related product/system information, with supporting calculations and fire test data, and the particular fire engineering strategy which has been developed for a specific building. The fire defence plan is to demonstrate a proper consideration for the fire safety, protection and evacuation of the users of the building (occupants, visitors and other users) and who may or may not have a health condition or impairment. This may be a requirement of national legislation. (ISO 21542 2011, Section 38.6)
	Evacuation training programme		Extracted from ISO 21542 (2011) Annex D.4: “Evacuation skills and self-protection from fire in buildings A ‘skill’ is the ability of a person – resulting from adequate training and regular practice – to carry out complex, well-organized patterns of behaviour efficiently and adaptively, in order to achieve some end or goal. Building users should be skilled for evacuation to a ‘place of safety’, which is at a safe distance from the building. Non-emergency/test evacuations should be carried out sufficiently often to equip building users with this skill. Fire protection measures and human management systems are never 100% reliable. It is necessary, therefore, especially for people with activity limitations and/or impaired senses, to be familiar with necessary guidelines for self-protection in the event of a fire emergency.”

Definitions	Human abilities and associated design considerations		Extracted from ISO 21542 (2011) Annex B (informative): “Human abilities and associated design considerations B.1 General Introduction The prime objective in designing, constructing and managing the accessible built environment is to ensure that, it satisfies the diverse needs of all of its intended users. Such an environment should reasonably satisfy the needs of any one individual without unreasonably compromising those of another. This is particularly important in areas of health and safety. In many instances, the use by specific individuals of assistive products assists them in using the built environment. Every effort should be made to address constraints such as limitations of space or topography on the development of new environments that suit everyone’s needs. Different constraints are likely to be encountered when attempting to modify the layout and structure of an existing building or external environment. However, as many as are feasible of the individual provisions within this International Standard should be adopted, whether the environment is newly constructed or an existing one is to be modified. Clause B.2 describes the principal human faculties that need to be considered when designing, constructing and managing the built environment. As well, the section highlights a number of design considerations that should allow the environment to accommodate different levels of performance. Physical, sensory and mental faculties vary from person to person. Diversity is normal. However, some differences may be heightened through age or social condition, be congenital or result from accident or illness. Disability may be temporary or permanent, or in transition. B.2 Physical abilities B.2.1 General Physical faculties include walking, balance, handling, pulling, pushing, lifting and reaching. Many activities involve simultaneous use of more than one of these skills. B.2.2 Walking For some people walking on the level or up gradients is difficult. Some people may have limited range of motion or may use a mobility device such as a wheelchair or a walker. They may need to stop frequently, to regain strength or catch their breath. In addressing the needs of people with walking limitations, the principal design considerations include: • a clear unobstructed path of travel and an appropriate width - the proximity of facilities to one another; • the ease of incline of gradients and of the pitch of steps and stairs; • the availability of seats; • the number of steps in a flight; • optional means of travel from one level to another; • the provision of handrails on both sides; • the evenness, firmness and slip-resistance of walking surfaces. To prepare for emergencies egress needs to be established by planning architectural and evacuation strategies. Specific accommodation and management systems need to be planned to provide assisted means of egress in the event of emergency, see Annex D. B.2.3 Balance People with difficulty in balancing are expected to benefit from controls within easy reach. A surface which a person may stumble against or walk into should be designed to limit abrasion. B.2.4 Handling Handling involves the use of one or both hands. Some people are left-handed. Others might, for a variety of reasons, not have the use

			of either one or both of their hands. Facilities and components should be designed to be suitable for use with one and with either hand. Handling includes gripping, grasping and manipulation. Each of these has a different purpose with specific design considerations. For instance, components should be designed to be graspable. Their circumference of the supporting structure and stability are critical. Manipulation involves the moving, turning and twisting of components with a hand or hands. For those who have limited manipulation abilities size and shape and ease of movement are critical. Manipulation by using a pushing, pulling or pressing action using a clenched fist, or by using the wrist or the elbow, is preferred. B.2.5 Strength and endurance Strength and endurance may be required on sloping paths and floors, stairways and long travel distances, when sustained effort may be needed. For those with limited endurance, frequent resting places are essential. People generally find it easier to push than pull. This is particularly so, if the individual uses a wheelchair. Nevertheless, self-closing devices on manual doors can be difficult for some people to operate, particularly if the doors are required to resist wind forces. For these reasons, doors that open and close automatically are preferred. B.2.6 Lifting Activities such as opening a vertically sliding sash window and an upward opening access gate, should be designed to be easily operated with minimal force. B.2.7 Reaching Telephones, desks, counters and work surfaces, electrical and other service controls, taps, door and window furniture should be positioned within reach. Comfortable reach ranges should be considered to ensure use by a greater number of people. A 'comfortable reach range' has been defined as one that is appropriate to an activity that is likely to be frequent and in need of precise execution and that does not involve stretching or bending from the waist. An 'extended reach range' has been defined as one that is appropriate to an activity that is likely, neither to need precision nor to be frequent and that can involve stretching or bending from the waist. Having components within easy reach is particularly important for those with more severe limitations in mobility. For wheelchair users, the reach range is limited depending on the seated position. Where reach is across a desk or worktop the range is limited by presence or design of the wheelchair's arms. The reach range is also dependent on the height of the person, the use of their arms and balance and mobility of the upper body. B.2.8 Speech Speech is the expression of thoughts by means of articulate sounds. Where two-way communication is required, the built environment should be designed to facilitate communication with information in visual and audible formats, with adequate illumination and appropriate alarm systems. B.3 Sensory abilities B.3.1 General These are abilities by which the body perceives an external stimulus. They include sight, hearing, touch, smell and taste. This International Standard does not deal with matters relating to smell and taste. B.3.2 Sight Vision allows an individual to be aware of the luminance of surfaces and objects and their form, size and colour. For people who are blind or have a severe vision impairment, the provision of suitable tactile walking surface indicators and tactile or

			acoustic warnings at hazardous locations, should provide information on using the built environment and should limit the risk of injury. The built environment can be designed for orientation by providing sound cues and tactile cues. Differences in friction between one floor surface, or one stair tread surface, and the next should be avoided. Therefore, adjacent surfaces that display different standards of slip-resistance, or that depend on raised surfaces, should be carefully considered. An effective visual contrast between surfaces or objects helps to identify critical locations. Simple and clear images should be used. Visual contrast between adjacent surfaces, and components should be carefully considered An environment that accommodates a broad range of visual characteristics should have: • a simple, logical and easily understood arrangement, preferably with intersecting routes at right angles to each other; • an easily discernible system of 'wayfinding' visual contrast between adjacent objects and surfaces where it is necessary to provide important information, • choices of colour that satisfy the needs of those with anomalous colour vision; • appropriate warnings of the edge of abrupt changes of level or the existence of obstructions; • no reflections from floor and wall finishes; • careful placement of mirrors and glazing, to prevent dazzling and confusion; • a suitable level of lighting, free of glare; • complementary audible information. B.3.3 Hearing Hearing allows an individual to be aware of sound, to determine its direction and, possibly, its source, and to discern its pitch, frequency, volume and variation. Its quality contributes to an effective means of communication and information. A low level of background noise is essential. Hearing enhancement systems amplify audible communication and can be used by people who have a hearing impairment. They include a direct wire system, an induction loop system, an infrared system and a radio frequency system. All of these systems transmit a signal. Special-purpose receivers are required for infrared and radio frequency systems, while hearing aids equipped with a T-switch are capable of receiving the signal from an induction loop system. Receivers can be equipped to be compatible with hearing aids. Written information that complements oral information concerning fire and other emergencies is especially important. The selection of structural and surface materials can make a substantial difference in audibility. Auditoriums, meeting rooms and reception areas can benefit from additional sound enhancement such as a hearing enhancement system. The careful design of illumination can assist in communication such as lip reading and sign language. Most people with hearing impairments use a hearing aid which amplifies all sounds caught by the microphone, making communications very difficult in noisy environments. B.3.4 Touch Touch stimulates the perception of an object through physical contact. For those individuals who use touch in the built environment, it is important to consider the selection of surfaces that do not cause distress or injury. Surfaces should be free of abrasions and not cause an allergic reaction. Some metals may cause adverse reactions when touched so their use should be carefully explored. B.4 Mental abilities B.4.1 General

			Mental faculties include those processes that are carried out in the mind of the individual. They include cognition, intellect, interpretation, learning and memory. To provide a usable environment for the population at large, all means of communication should have an immediate impact and be easily understood. B.4.2 Cognition Cognition is the acquisition of knowledge and understanding through thought, experience and the senses. By this means, and through recognition, people can understand and interpret signs and other forms of information or instruction. B.4.3 Intellect Intellect is the faculty of reasoning and understanding objectively, especially with regard to abstract matters. B.4.4 Interpretation Interpretation involves understanding messages and information as having a particular meaning or significance. B.4.5 Learning Learning is central to many aspects of understanding, reasoning and interpretation. A failure to recognise words and their meanings may adversely affect an individual's ability to move successfully and safely in the built environment. B.4.6 Memory Memory is the ability to remember information. As people age, some find it increasingly difficult to absorb new information so changes in the environment should be carefully considered before implementation B.4.7 Design considerations that take account of mental abilities Aural and visual messages should be simple, clear and have immediate impact. Figures, symbols and simple words are likely to be the most effective. Symbols should be instantly recognisable as representing images seen and activities undertaken in everyday life. Special design considerations: • simple and clear planning layout; key rooms or spaces designed so they are easy to find; • Whenever changes are undertaken, clear and simple information with respect to the new layouts should be provided, • self-explanatory environment; design should indicate the use of the built environment or elements in it; • unnecessary complexity should be avoided, • simple, intuitive design of circulation routes; • doors designed so that their operation is intuitive, whether they are push, pull or sliding doors; • text signage that uses plain language; • aural and visual messages which are conspicuous, concise, comprehensible; • wayfinding plans or maps that clearly indicate the person's position in the building or facility, and which do not include extraneous information; • wayfinding cues that are easy to follow; e.g., tactile, graphic, audible or architectural; • directional and other information which combine text with universally recognisable symbols; • signs with graphics that are in conformance with ISO 7000 and ISO 7001; • in areas where key cards are used for access, such as hotels, the need for fine motor control and precise timing of the swipe of the card in the reader should be minimized. Messages should be conspicuous, concise, comprehensible and relatively frequent. B.5 Additional factors. B.5.1 Accommodating the developing child

			An element of risk is an essential part of a child's development. It is important to ensure that the built environment is safe for children. B.5.2 Accommodating ageing adults The life span within the human population is increasing. More and more we expect to maintain an economic and social life within both the public and private domains as we age. However, many human faculties are in marked decline as we age and familiarity with a particular environment is an aid. B.5.3 Diversity of stature There is a wide diversity of stature within the human population. Predominantly, this has to do with the average height of people in various parts of the world. The increase in tourism, business travel and population migration has led to a demand for more rationalisation, internationally, in the use of anthropometrics and ergonomics and in their influence on the design of the built environment. The provisions in this International Standard include ranges that should accommodate those regional differences. The ranges have been set so that member nations who decide to adopt specific criteria that reflect their own circumstances do not unduly inconvenience other individuals. The ranges included for the positioning of components or the heights of, for instance, steps, should also recognise the needs of those who do not reach their anticipated full height. Changes in diet and an increasing use of the motor car for short journeys, for instance, have combined in a trend towards increased girth and weight of some populations. It remains to be seen whether these later lead to demands for an increase in specific spatial and stability standards. These matters are beyond the scope of this International Standard."
Public education			An example of a personal emergency evacuation checklist is provided in NFPA (2007).