



Lifts Used During Evacuation



2013

Handbook

NON-MANDATORY DOCUMENT



LIFTS USED DURING EVACUATION

HANDBOOK

2013

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Preface

The Inter-Government Agreement (IGA) that governs the ABCBC places a strong emphasis on reducing reliance on regulation, including consideration of non-regulatory alternatives such as non-mandatory guidelines, handbooks and protocols.

This Handbook is one of a series produced by the ABCBC. The series of Handbooks have been developed in response to comments and concerns expressed by government, industry and the community that relate to the built environment. The topics of Handbooks expand on areas of existing regulation or relate to topics which have, for a variety of reasons, been deemed inappropriate for regulation. The aim of the Handbooks is to provide construction industry participants with non-mandatory advice and guidance on specific topics.

The evacuation of people using lifts, particularly from high-rise buildings, has been identified as an issue that requires relevant and uniform guidance. However, the scope of this Handbook is limited to aspects of lifts as a means of evacuation and does not explore other aspects of egress such as exit widths, additional handrails and exit ramp gradients. Although the use of lifts for evacuation will intrinsically rely on management practices in an emergency, this Information Handbook contains limited information on evacuation procedures.

Lifts Used During Evacuation has been identified as an issue that requires consistent uniform guidance.

This Handbook has been developed to increase the awareness of practitioners of the issues that should be considered in using lifts for evacuating people from buildings in emergencies. This Handbook addresses the issues in generic terms, and is not a document that sets out specific requirements or recommendations for any particular project.

Throughout this Handbook there are references to International and Australian Standards which may be used for guidance. As the National Construction Code (NCC) does not contain any Deemed-to-Satisfy Provisions for using lifts during evacuation, they are not NCC reference documents.

In NCC 2016, the General Provisions were re-written to make the performance-based format easier to understand by clarifying that only the Performance Requirements must be met — using the Deemed-to-Satisfy Provisions is just one option for doing this. Terminology was updated — Alternative Solutions are now called Performance Solutions — and a new diagram was introduced to help understand the NCC compliance structure.



These changes flow on to the performance 'hierarchies' at the beginning of each Part of the NCC. Also, as part of the focus on performance, the Objectives and Functional Statements for Volume One have been moved to the Guide; in Volumes Two and Three they are now Explanatory Information. This reflects the intention of the Objectives and Functional Statements, which is to provide guidance on the mandatory Performance Requirements. Restructuring these parts of the NCC has helped put the focus back on performance, and is a key part of the ABCB's drive to engender a performance mindset and promote innovation throughout the building, plumbing and drainage sectors.

This Handbook was first published in 2013. Editorial changes were made to this document in 2016 to ensure currency with NCC 2016.

Acknowledgements

The ABCB acknowledges the valuable contribution of the Approval Authorities in the States and Territories and the following organisations:

- Engineers Australia
- Australasian Fire and Emergency Service Authorities Council
- Australian Elevator Association
- Australian Institute of Building Surveyors
- Fire Protection Association Australia
- Master Builders Australia
- Housing Industry Association
- Property Council of Australia
- Royal Institute of Chartered Surveyors
- Society of Fire Safety – Engineers Australia
- Physical Disability Australia

In addition, comments provided by Messrs Mark Randle and Neil Hitchen of Arup Pty Ltd were appreciated.

Although the above organisations have assisted in the preparation or review of this document it is fair to say that there may not be consensus on all the views expressed on this critical life safety matter in this document. This is fundamentally because for some scenarios there may be a gap between what fire authorities may want in order to safely evacuate a building in an emergency and what the international lift industry can currently provide.

Many experts are of the view that there are still some refinements that need to be made in terms of the level of intelligence and sophistication of the lift control system in responding to calls from fire floors for lifts to be used for evacuation. Were it not for the ongoing construction of very tall buildings and the legitimate rights for life safety of people with mobility limitations, a moratorium on using lifts for evacuation would be desirable in order to allow the international lift and the building industry to develop what is needed. In the absence of such sophistication, a more conservative approach is reflected.

Prior to publication, a draft of this Handbook was made available on the ABCB website to enable stakeholders and the public to make comment. The comments provided by interested parties assisted in the further development of the Handbook.

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1 Introduction

Reminder:

This Handbook is not mandatory or regulatory in nature and compliance with it will not necessarily discharge a user's legal obligations. The Handbook should only be read and used subject to, and in conjunction with, the general disclaimer at page i.

The Handbook also needs to be read in conjunction with the relevant legislation of the appropriate State or Territory. It is written in generic terms and it is not intended that the content of the Handbook counteract or conflict with the legislative requirements, any references in legal documents, any handbooks issued by the Administration or any directives by the Appropriate Authority.

1.1 Objective and scope of this Handbook

The objective of this Handbook is to provide guidance in developing a Performance Solution that enables people (particularly those with a disability or health condition) to egress a building, or part of a building, using lifts. The guidance is particularly applicable to high-rise buildings but could be applied to a range of other buildings.

The National Construction Code (NCC) considers a “building” to also be read as “part of a building” so evacuation can occur from one part of a building to another part.

This Handbook is not intended to cover all aspects of a building’s evacuation strategy; in particular, it does not cover in detail the various management initiatives that will need to be put in place and upon which safe evacuation is heavily dependent. This Handbook is to complement the NCC objective of fire safety and primarily focuses on the fire safety systems and lift reliability systems needed for the success of an overall evacuation strategy.

The objective of safely using lifts for evacuation is not intended to diminish the importance of other evacuation measures including exits and is not intended to reduce the number of exits, particularly the number of stairways.

This Handbook has been prepared with the intention of providing guidance on the risks, equipment limitations and other matters a designer should address when considering a Performance Solution involving the use of lifts during evacuation.

This Handbook is not a definitive design reference for specialists or experts but only intended to provide general introductory knowledge on the subject, the major issues that need to be considered and how the NCC is applied.

The International Organization for Standardization (ISO) has developed a standard specifically on requirements for lifts used to assist in building evacuation – ISO/TR 25743:2010(en) Lifts (elevators) — Study of the use of lifts for evacuation during an emergency.

Some of the lift operational goals discussed are still under development and so may not be available at this time. To ensure a harmonised approach, they are being developed through the ISO process. In particular, to achieve some of the operational goals, communication protocols between systems will need to be developed as well as the special functions desired by some designers and authorities. The lift industry advise that lifts, including their control and safety software, are imported and not developed or modified in Australia.

However, there are building features that can contribute to safe evacuation using lifts and the reliability of lifts such as protecting the lifts from fire, smoke and water and protecting the building occupants waiting for the lifts.

Appendix A contains a list of relevant NCC definitions used in this document.

1.2 Limitations

This Handbook is not intended to:

- override or replace any legal rights, responsibilities or requirements; or
- provide users with the specifics of the NCC.

This Handbook is intended to make users aware of provisions that may affect them, not exactly what is required by those provisions. If users determine that a provision may apply to them, the NCC should be read to determine the specifics of the provision.

1.3 Target readers

This Handbook is primarily directed at those with a design or regulatory role. These are building certifiers, HVAC engineers, lift engineers, fire engineers, architects and other building designers. It is important that all disciplines involved in the design process and those responsible for emergency planning, understand the issues and agree on a strategy. It will also be of interest, to property owners, building operators, facility management personnel, maintenance contractors, and the general public, as they are all stakeholders in the evacuation lift issue.

In addition to this Handbook fire engineers are likely to use publications such as the “International Fire Engineering Guidelines” or the “Guidelines for designing fire safety in



very tall buildings” by the Society of Fire Protection Engineers. Lift engineers are likely to use the ISO/TR 25743: 2010(E) Technical Report “Lifts (elevators) – Study of the use of lifts for evacuation during an emergency”. Building owners are likely to use one of the Standards Australia publications on “Planning for emergencies”. The “International Fire Engineering Guidelines” is available from the [ABCBC website](http://www.abcb.gov.au): www.abcb.gov.au.

Finally, this Handbook does not specify the qualification of people appropriate to develop a Performance Solution. It is the responsibility of the jurisdictions as to whether practitioners, including engineers are required to be registered. Note: the NCC contains a definition of a professional engineer.

1.4 Other handbooks by the ABCBC

The ABCBC has produced a range of Handbooks and other educational material relevant to topics related to the NCC. They can be downloaded from the [ABCBC website](http://www.abcb.gov.au): www.abcb.gov.au.

2 Background

2.1 The need for a Handbook

The NCC has always contained provisions for people with a disability to access buildings. Prior to the national code, the building code of some jurisdictions also had access provisions. However, there have been no particular provisions for people with a disability to egress from a building in an emergency beyond some basic ones for ambulant people. Instead, reliance has been placed on emergency plans and other people providing assistance.

The Commonwealth Disability Discrimination Act 1992 (DDA) places responsibility on the community to provide equitable, independent and dignified access to a building for people with a disability. However, the DDA has unjustifiable hardship as a defence in the event of a complaint. What is likely to cause unjustifiable hardship was considered in developing the Premises Standard.

As a result of the DDA, the ABCB has progressively enhanced its access provisions with equity being the principle. As egress is highly dependent on management practices—with different practices depending upon the situation—the NCC has no provisions for using lifts to evacuate a building. Instead the ABCB has monitored overseas practices and developments with international standards, and developments by lift manufactures. Appendix A contains a summary of developments internationally and Appendix C contains a list of relevant documents for further reading.

The enhancement of the NCC access provisions has been carried out in association with the Australian Government Attorney General's Department, the Australian Human Rights Commission, the disability sector and industry. This has resulted in consistency between the NCC and the Australian Government's Premises Standard.

As with access to buildings, a key principle with evacuation should be the ability for all people to evacuate unassisted, where practical.

Historically, evacuation routes have been provided in the form of exits, exit stairways and exit ramps. All of which can form barriers for some people with a disability. Lifts however, have only been used by the emergency services personnel to access the building and to carry out search and rescue operations. The current Deemed-to-Satisfy (DtS) Provisions within the NCC are based on this strategy. With this traditional approach, rescue times will increase as buildings get taller unless alternative strategies are developed.

Of particular concern are those people who are movement impaired. This has led to reliance on emergency plans. These plans are often developed by tenants after the building has been constructed and so may have missed the opportunity to contribute to the initial design. Plans also rely on human intervention resulting in a risk of them not being implemented as intended unless repeatedly reinforced.

Although the NCC does not have specific requirements or DTS Provisions for places where people can safely wait for rescue (commonly termed 'refuges') they are recognised as a lift safety strategy internationally. The effective use of refuges relies on other people assisting occupants to evacuate. This task is usually undertaken by the emergency services personnel who may take some time to arrive. There is a limit to the time people can be protected in place and how long they are prepared to wait before panicking. This Handbook is about using lifts during evacuation and although refuges may be part of a Performance Solution, their technical specification is not detailed in this document.

As buildings get higher, and as the demographic profile and the condition of building occupants change, there are more people in the building who will be limited in their ability to use an exit stairway all the way to a place of safety. An alternative would be to have the option of using a lift to evacuate.

Any means of evacuation in a fire carries a risk and it should be kept in mind that even historic evacuation routes have not been risk free. Using a lift for evacuation will also carry a risk.

This Handbook is not intended to compare an evacuation strategy using exits, egress lifts. Nor is it intended to compare protect-in-place, using refuges or other safe places. That is for the designers and the appropriate State or Territory authorities responsible for building regulation and emergency services matters to undertake.

Fire authorities have traditionally been supportive of designs which provide equitable evacuation opportunities for all occupants of a building. However, the use of lifts in a fire emergency, prior to the arrival of emergency services personnel, is a concept that differs from the more prescriptive DTS Provisions of the NCC. This in turn requires careful consideration, proving and demonstrating that any potential modes of failure are identified and adequately addressed.

It is fair to say that fire authorities are of the view that lifts used for evacuation should only be considered within buildings that are fully sprinkler protected and have an appropriate emergency and maintenance management structure in place.

Finally, some designers and developers have proposed using lifts as a means of removing one fire isolated exit stairway. This is not an objective of this Handbook and any Performance Solution involving a reduction in the number of exit stairways would need to comply with the Performance Requirements for exits. Fire authorities are also of the view that the use of lifts as part of an evacuation strategy should only supplement the use of fire isolated stairways.

2.2 Challenges in using lifts for evacuation

2.2.1 Range of emergencies

There are many emergencies which may result in a building, or a part of a building, needing to be evacuated. These emergencies include fire, earthquake, explosion, a security threat, impact, flooding, storm damage and chemical, gas or biological release. The likelihood of one or more of these occurrences leading to an evacuation will vary depending upon the location and the use of the building.

While some Objectives, Functional Statements and some Performance Requirements of the NCC use the broader term emergencies, most egress DtS Provisions focus on fire. Note: the warning sign regarding not using lifts in an emergency is specifically about fires.

For some emergencies it may be appropriate for a lift to be used for evacuation. Note that the warning sign regarding not using lifts in an emergency is specifically about fires. The decision needs to be made based on the threat to life in using a suitable lift, possibly one that is a distance from the emergency, where this risk it may be considered safer to evacuate via a lift rather than staying in the building or evacuating towards a hazard.

2.2.2 Occupants needing a lift or assistance to evacuate

A key objective of good building design is for all occupants to evacuate safely. Historically there has been an expectation that mobile people will use the exits and exit stairways while less mobile people will need assistance; possibly relying on others or waiting in a safe place for emergency services personnel to arrive.

Generally high-rise buildings have large populations. This is likely to mean that there will be an increased number of people who cannot use stairs, or may have considerable difficulty in doing so. This may include the following people:

- Those that have a permanent mobility disability and use a wheelchair or walking device.
- Those that have a sight impairment or cognisant disability.
- Those that have a temporary mobility difficulty such as through a sporting, industrial or road accident.
- Those that have a health issue such as obesity, a heart complaint, asthma etc.
- Those that are at a late stage of pregnancy.
- Those that are accompanied by children and infants, possibly in prams or strollers.

Although stroller-bound infants are not classified as having a disability, they are another justification for an alternative to stairs. From a practical view point, infants too young to walk will need assistance to evacuate, be that in prams or strollers, being carried or being lead. There may also be more than one infant per adult that needs to be carried. A particular instance would be where an early childhood facility is located in an upper storey and a small number of carers may have to evacuate a larger number of infants. A building such as an office or shopping centre that has people visiting upper levels with infants in strollers also present a problem. Evacuating the infant down stairs, is likely to result in the stroller being abandoned and the child being carried.

While assisted evacuation or using refuges may be appropriate in some circumstances, evacuation using a lift—if available and low risk—may be the most desirable and viable option.

2.2.3 Technical innovation

As with many aspects of modern living, there is rapid change in technology. New products are continually coming on to the market that can assist people in an emergency. These include devices and systems for detection, warning, communication and escape. New technologies however, can mean a lack of familiarity and require training or assistance.

The cost of sophisticated monitoring equipment, control equipment and “intelligent” software systems, is rapidly falling. For example, some car parking spaces in shopping centres are now monitored for occupancy and that information is conveyed to patrons looking for a space. The lift industry is also introducing innovative technologies and with using lifts for evacuation now being of world-wide interest, there is likely to be more sophisticated lift controls and interfacing with alarm systems in the future.

One of the reasons why the NCC is a performance-based code is to take advantage of both innovative products and their cost-effectiveness.

2.2.4 Occupant behaviour

The NCC and many other building codes around the world have prohibited or discouraged the use of lifts for egress in a fire. To this end most lifts in use today have a sign on the lift call button instructing building occupants not to operate the lift in the event of a fire.

While lifts could be permitted to assist egress in certain circumstances, they may not be permitted in others.

The possible uncertainty in the minds of occupants, particularly visitors, needs to be managed. Emergency plans need to be specifically tailored for the particular building including destination awareness and control.

It has taken many years of conditioning building occupants to follow evacuation plans. However, there is still a natural tendency, particularly with people unfamiliar with a building, to want to leave by the same means they entered. It is likely that visitors to a building are more familiar with the location of the lifts than they are the location of the exit stairways.

Threats of an emergency, or safe actions in an emergency, can be real or perceived with the occupant making decisions on limited information. An extensive training program for both staff and regular occupants would be essential where lifts are available for all or some occupants to use. Factors that may still affect their decision include the distance to the street exit, crowd density and lift waiting time.

The behaviour of occupants will differ when they are in groups of colleagues or friends, as opposed to being on their own or with strangers. People may be influenced rightly or wrongly by group decisions. Alternatively, they may be working on their own out-of-normal hours and not be influenced by positive group dynamics.

When an emergency occurs, the building occupants may be engrossed in their work task or not have visual or other sensory confirmation of the emergency. In residential buildings such as apartments or hotels, occupants could also be asleep and more time would be needed to alert occupants and organise evacuation. Therefore it is important that people:

- Receive instruction.
- Understand the instruction, with language possibly being an issue.
- Interpret the instruction for their situation and respond appropriately.

Where evacuation lifts are to be available, some people would use the lift while others would use the exit stairways. The results of some studies can give an indication of the possible percentage of people that would use a lift. These results indicate that this will depend upon the height of the storey above ground or a known safe level, their mobility and health, the time they may have already waited for the lift and the number of other people waiting. Generally, the higher the building, the more people may want to use the lift unless there is an obvious wait.

There are other issues involving occupant behavior that cannot be addressed by technology alone and need appropriate management practices to be put in place. For example:

- How are people waiting on a landing likely to behave when a lift arrives that is full?
- How are people with a disability given priority over others if already in a lift?
- How are people in a lift likely to behave when the lift is to travel to what is supposedly a safe place on another storey rather than descending to the street exit?
- How would people react if there was a delay in the arrival of the lift?

2.2.5 Management practices

The traditional philosophy when designing for egress from a building, and conditioning of building occupants, has meant that management practices have been based on using exits including horizontal exits and exit stairways, rather than lifts.

Where suitable, lifts are now being considered to assist evacuation. However the emergency plans need to be very specific for that evacuation means and for the particular building. These are likely to involve signage, announcements, training of staff and a higher level of supervision, monitoring and maintenance of essential equipment.

3 The National Construction Code

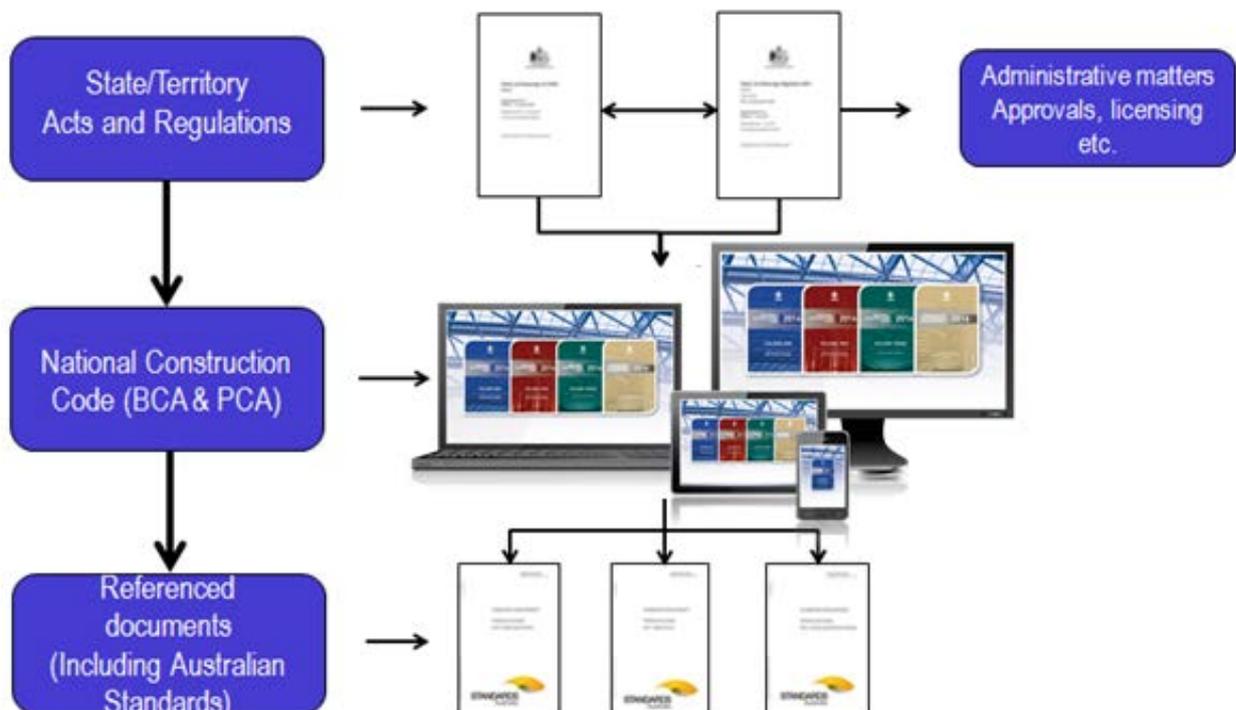
3.1 Legislation governing building, plumbing and drainage work

The NCC is given legal effect by relevant legislation in each State and Territory. This legislation prescribes or “calls up” the NCC to fulfil any technical requirements which have to be satisfied when undertaking building work or plumbing and drainage installations.

Each State and Territory’s legislation consists of an Act of Parliament and subordinate legislation which empowers the regulation of certain aspects of building work or plumbing and drainage installations, and contains the administrative provisions necessary to give effect to the legislation.

The NCC should be read in conjunction with the legislation under which it is enacted. Any queries on such matters should be referred to the State or Territory authority responsible for building and/or plumbing regulatory matters. Refer to Figure 3.1 below.

Figure 3.1 Legislative hierarchy for building work



3.2 The Australian Building Codes Board

The Australian Building Codes Board (ABCB) is a joint initiative of all three levels of government in Australia and includes representatives from the building and construction industry, and the plumbing industry. The Board was established by an Intergovernment Agreement (IGA) signed by the Commonwealth, States and Territories on 1 March 1994.

The Board's mission is to address issues relating to safety, health, amenity and sustainability in the design and performance of buildings through the NCC, and the development of effective regulatory systems and appropriate non-regulatory solutions.

A new IGA was signed by Ministers, with effect from 30 April 2012. For further information about the Board and the ABCB office, visit the ABCB website at www.abcb.gov.au.

3.3 The NCC

The ABCB is, amongst other roles, the standards writing body for the States and Territories. The series of construction codes is collectively named the NCC. The objective of the NCC is to incorporate all on-site construction requirements into a single code. The NCC comprises of the Building Code of Australia (BCA) as Volume One and Two; and the Plumbing Code of Australia (PCA), as Volume Three.

Volume One of the NCC pertains primarily to Class 2 to Class 9 buildings while Volume Two pertains to Class 1 and 10 buildings. Volume Three pertains primarily to plumbing and drainage associated with all classes of buildings.

The NCC is a uniform set of technical provisions for the design and construction of buildings and other structures throughout Australia whilst allowing for variations in climate and geological or geographic conditions. Only Volume One has requirements and provisions for lifts.

All three volumes are drafted in a performance based format allowing a choice of DtS Provisions or the flexibility to develop Performance Solutions based on existing or new innovative systems, products and designs.

To assist in interpreting the requirements of Volume One, the ABCB also publishes a non-mandatory Guide to Volume One.

The NCC contains many definitions in Part A1 Interpretation (Volumes One and Three) and Part 1.1 (Volume Two). These definitions are shown in the text of the NCC in italics.

When readers come across defined terms they should refer to the definition as it may be very different from what may be considered common usage or what a dictionary contains. The definitions are specifically tailored for the NCC context. Some are explained in Appendix B.

Part A3 in Volume One of the NCC contains descriptions of the various building classifications, such as a Class 5 being “an office building used for professional or commercial purposes, excluding buildings of Class 6, 7, 8 and 9”. Where there is doubt as to a building’s classification the building certifier should be consulted. The NCC Classifications are reproduced in Appendix B.

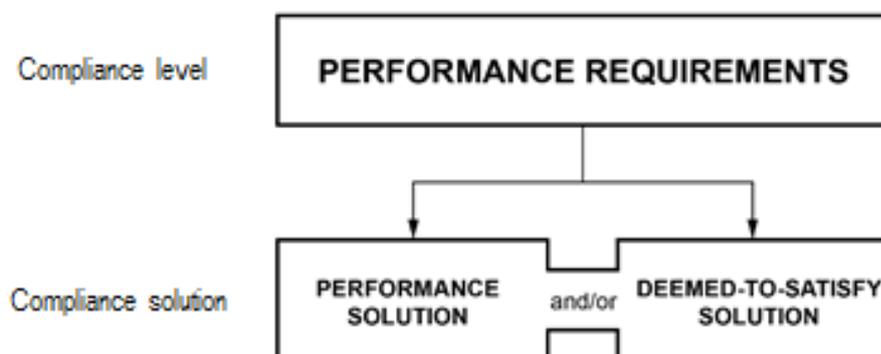
3.3.1 The NCC Compliance Structure

Practitioners must meet the Performance Requirements. This can be achieved by using a Performance Solution, a DtS Solution, or a combination of both.

The top level of the NCC Compliance Structure is the compliance level, i.e. the Performance Requirements. The bottom level is the compliance solution, which is a Performance Solution or DtS Solution.

The structure of the performance based NCC is shown in Figure 3.2 below.

Figure 3.2 Compliance structure



Whilst all three volumes of the NCC are performance based, since this Handbook is primarily focussed on lift requirements contained in NCC Volume One, the descriptions used below are relevant to building only.

3.3.2 The Performance Requirements (mandatory)

The Performance Requirements specify the minimum level of performance which must be met for all relevant building materials, components, design factors, and construction methods. They are the core of the NCC and are the only parts of the code with which compliance is mandatory¹. They are expressed in both quantitative and qualitative terms.

The Performance Requirements set the level of performance that must be achieved by a compliance solution.

Alert:

The Objectives and Functional Statements provide guidance as to the intent and interpretation of the Performance Requirements. They are provided as explanatory information in the Guide to NCC Volume One.

3.3.3 The Objectives (guidance)

The Objectives describe the community expectations for buildings.

3.3.4 The Functional Statements (guidance)

The Functional Statements describe how buildings are to achieve the objectives.

3.3.5 NCC Compliance Solutions

Compliance with the Performance Requirements is achieved by using -

- a solution which complies with the DTS Provisions; or
- a Performance Solution; or
- a combination of a Performance Solution and the DTS Provisions.

Essentially the DTS Provisions prescribed in the NCC are only some of the Compliance Solutions that will meet the Performance Requirements. The other Compliance Solutions that will meet the Performance Requirements on a case-by-case basis are Performance Solutions. A Performance Solution is a Compliance Solution that is outside the DTS

¹ The General Requirements of NCC Volume Two contain additional mandatory requirements. They are found in Section 1.

Provisions yet is found to be compliant with the Performance Requirements for the particular application.

3.3.6 Assessment Methods

A Performance Solution needs to be assessed according to one or more Assessment Methods and will only comply with the NCC if the Assessment Method used to determine compliance has found that the Performance Requirement has been satisfied.

The following Assessment Methods are listed in the NCC and each, or any combination, can be used:

- Evidence to support that the use of a material, form of construction or design meets a Performance Requirement.
- Verification Methods such as-
 - the Verification Methods in the NCC; or
 - such other Verification Methods as the appropriate authority accept for determining compliance with the Performance Requirements.
- Comparison with the DtS Provisions.
- Expert Judgement.

The Assessment Method needs to demonstrate that the Performance Solution meets the Performance Requirement with some appropriate verification criteria being applied or that the Performance Solution is equal to or better than the DtS Provisions, again with some measurable or demonstrable criteria being used to compare the two. For an evacuation lift there are no DtS Provisions.

3.4 Building law compliance

The responsibility for administering building law rests with the relevant State or Territory Administration. A building certifier is the registered practitioner who can certify that the building complies with the NCC. The building certifier may be a Council employee or a private operator.

The responsibilities of the State or Territory Administrations include building legislation matters, appeal boards, registration of practitioners and how the NCC is applied to existing buildings.

3.4.1 Certification to the NCC DtS Provisions

Building certifiers are authorised by the State and Territory Administrations to certify designs as complying with the NCC DtS Provisions and grant building approvals. The building certifiers may be private practitioners or local government officials and in turn be required to use, or nominate to use, other specialists, such as fire engineers, to certify specific aspects of building designs.

3.4.2 Certification to the NCC Performance Requirements

Building certifiers are also authorised by the State or Territory Administration to certify Performance Solutions as complying with the NCC Performance Requirements. Submissions for their consideration and their decisions should be fully documented and copies of all relevant documentation retained.

The kind of documentation which should be prepared and retained will depend upon the particular solution but generally will include the following:

- Details of the Performance Solution including all relevant plans and other supporting documentation.
- Details of the relevant Performance Requirements.
- The Assessment Method or methods used to establish compliance with the relevant Performance Requirements.
- Details of any Expert Judgement including the extent to which the judgement was relied upon and the relevant qualifications and experience of the expert.
- Details of any tests or calculations used to determine compliance with the relevant Performance Requirements.
- Details of any Standards or other information which were relied upon.

3.4.3 Certification to modified NCC Performance Requirements

Some Building Administrations also have the power to approve modifications to the NCC Performance Requirements. However, the NCC Performance Requirements for access and egress are part of the “Access Code” in the Disability (Access to Premises-Buildings) Standard 2010 (Schedule 1) and so remain in force under the DDA. Although DP7 has been added to the NCC since the Access to Premises-Buildings Standard was gazetted, the NCC may differ from the Access to Premises-Buildings Standard to the extent that the standard under the DDA is not reduced.



3.4.4 Compliance with other laws

Designers also need to be aware of other laws that may be in force and be applicable to lifts and evacuation. All jurisdictions have safe work legislation that covers the safety of lifts, installers, passengers, and maintenance personnel.

Some jurisdictions may have other requirements for building owners or occupiers.

4 Building Owner's Responsibility

Typically the building owner, and in some jurisdictions the building occupier, has a responsibility under building law to provide a safe environment in accordance with the NCC and for ongoing maintenance of fire safety systems under workplace safety or other legislation. The building owner's responsibility remains unchanged whether the solution is a DtS Solution and/or a Performance Solution. However, how that responsibility is addressed is likely to be markedly different.

The NCC provisions may require a fire control room, fire control centre or a fire indicator panel all of which are integral to the emergency procedures for the building. Considering these emergency procedures is also a requirement under DP7. This is likely to involve the building owner preparing and maintaining an emergency plan. These plans would need to be current and practiced periodically. It is worth reinforcing that to use a lift to assist evacuation during a fire is a relatively unique strategy. Most people would be unfamiliar with this and therefore emergency response procedures would need to be put in place.

As lifts and their associated life support systems would become essential elements of the evacuation strategy, building owners have the responsibility for the availability and reliability of those systems.

4.1 Planning for emergencies in facilities

Workplace legislation in force in the various States and Territories requires that there be planning for, and management of, emergencies. Safe Work Australia, in conjunction with the governments, has produced 'Model Work Health and Safety Regulations' (March 2016) which includes provisions for emergency plans.

In addition, Standards Australia has produced two Australian Standards that provide guidance on the management of an emergency including planning for the evacuation of a building. They are AS 3745, 'Planning for emergencies in facilities' and AS 4083, 'Planning for emergencies—Health care facilities'. These standards are to enhance the safety of people in facilities by providing a framework for emergency planning and utilising the built facilities as appropriate.

These two standards outline minimum requirements for the establishment, validation and implementation of emergency plans. These emergency plans provide for the safety of occupants and visitors, leading up to and during an evacuation. They include the following:

- The formation, purpose, responsibility and training of an emergency planning committee.
- Emergency identification.
- The development of an Emergency Plan.
- The development, testing and validation of emergency response procedures.
- The establishment, authority and training of an emergency control organisation.
- Emergency education and training.
- The roles of the Emergency Control Organisation (ECO), namely the Floor or Area Wardens and the Chief Warden in the case of AS 3745 and the Emergency Coordinators and Emergency Officers in the case of AS 4083.

While containing sound advice it should be recognised that AS 4083 was prepared with the more conventional emergency egress procedures in mind and not evacuation using lifts. AS 4083 specifically advises against using lifts unless authorised by the fire authority.

AS 3745 advises that lifts and escalators should not be relied upon as a means of evacuation from fire unless their suitability for that purpose has been nominated through a regulatory approval process. AS 3745 also refers to lifts being taken into account when determining the number of Wardens needed for a facility.

While most buildings will have ECO personnel available during normal occupancy times, out-of-hours occupancy needs to be considered as part of the emergency plan with provisions put in place. Some buildings are unlikely to have Wardens unless they have 24hour security staff. In these circumstances it may be prudent to use a larger factor of safety when determining the number and mobility of people using the lifts because-

- without Wardens to direct mobile people to the stairway, more people may want to use the lifts rather than stairs; and
- there may be unwell people needing assistance in a residential building; and
- there are residential buildings that are rented on a serviced apartment basis and so have transient tenants unfamiliar with the egress provisions.

4.2 Personal Emergency Evacuation Plans

AS 3745 also gives guidance on preparing Personal Emergency Evacuation Plans (PEEPs) for people with a disability.

PEEPS are a key component of the overall emergency plan for occupants with a disability in a workplace or residential situation. The implementing of each plan then becomes part of staff and occupant training.

History has shown that people with a disability have a much greater chance of safely evacuating a building if they take charge of their own egress and utilise ECO personnel to assist them or identify work colleagues who agree to help them. These arrangements would need to be specified in the emergency plan.

If a lift is to be used for evacuation, it should be documented in the emergency plan as part of the PEEP and in the building's evacuation procedure. Being unique, it will need all roles to be clarified including those of Wardens, emergency services, assistants and individuals.

Not only is each building unique but where lifts are to be used for fire response evacuation as part of a Performance Solution, additional questions may arise including-

- who may use the lifts, and
- how may the lifts be used, and
- are the lifts to be used in conjunction with refuges, protected landings (as staging areas) or safe floors?

This means that the PEEP for each occupant and building needs to be very specific. The training and emergency response exercises will also need to highlight this.

4.3 Emergency evacuation personnel and training

Emergency evacuation personnel include the Chief Warden, Floor or Area Wardens and where appropriate, the people at the control centre. All will need to be trained in their duties and in the unique features of the particular building.

ECO members may need to make decisions and provide clear instructions as to who can use lifts in an emergency. Appropriate members of staff should be selected with a contingency plan for when they are absent. Periodically staged emergency response exercises need to be carried out to monitor the Wardens performance in accordance with the emergency plan. Again, AS 3745 provides guidance.

If using lifts for egress is part of the evacuation strategy, additional ECO members may be needed at the lift landings to manage possible crowding and to help those who need assistance. In some cases, such as schools, they may also need to take over the operation of the lifts as the Floor or Area Wardens may be elsewhere on the floor looking for missing staff.

ECO members need to be available at all normal occupancy times and provisions need to be made in PEEPs for out-of-hours occupation.

The emergency services personnel will need to be briefed on the unique features of the building, the emergency evacuation strategy and how to access lifts in shafts.

4.4 Emergency services

The design of lifts that are to be available for use during evacuation need to consider the role of the emergency services personnel and in particular a building's fire services. Fire brigade intervention for the building will involve getting control over lifts upon arrival, and may mean the continued use of the lifts for evacuation, search and rescue and access to the fire floor. The Australasian Fire and Emergency Service Authorities Council (AFAC) have a Fire Brigade Intervention Model as may have the particular jurisdiction, either of which may be imposed. The Metropolitan Fire and Emergency Services Board of Melbourne, for example, have Guideline GL-31 "Use of Lifts for Evacuation".

4.5 Maintenance of emergency systems

The NCC details the required performance of the building and its systems when it is new, refurbished or undergoing a change of classification—effectively when building approval is required by the building law. Maintaining the building and its systems at the design level of performance is the building owner's responsibility. Although for most NCC requirements there is no specified inspection or enforcement regime for the frequency of such inspections.

While not providing a national approach, some jurisdictions also impose requirements for the maintenance of essential services. Fire authorities may also have an inspection regime however, responsibility for maintenance remains with the building owner. Operation and performance also needs to be periodically checked as part of the Emergency Plan. AS 1851 "Routine testing of fire protection systems and equipment" provides guidance on inspecting and testing the emergency plan and associated elements for the controlled evacuation of buildings.

The maintenance regime needs to be documented in a form that can be easily passed on from owner to owner over the building's life.

5 Current NCC Requirements for Egress

The NCC is clear on how to go about complying with its provisions and this is explained in Clause A1.5 of the NCC Volume One. Clause A0.7 gives the options for compliance when a Performance Solution is used.

There are a number of current NCC Performance Requirements for evacuating a building. They include considerations such as:

- A sound system and an intercom system to warn occupants of an emergency.
- A communication system to warn hearing impaired occupants of an emergency.
- Suitable evacuation signs.
- Signs or other means to instruct occupants about the use of a lift during a fire.
- Means of evacuating from buildings.
- Dimensions of paths of travel to exits.
- Evacuating occupants from a fire with evacuation routes being maintained while occupants evacuate that part of the building.
- Fire detection systems and appropriate fire suppression systems such as a fire hose reel system, fire extinguishers, a fire hydrant system or a sprinkler system.
- One or more passenger lifts fitted as an emergency lift to facilitate the activities of the emergency services personnel plus having stretcher facilities in at least one emergency or passenger lift.
- Suitable facilities to co-ordinate emergency services personnel intervention during an emergency.

Many of the above requirements take into consideration the height of the building, the number of storeys connected (or passed through) by evacuating occupants, and the characteristics of those occupants. It also should be noted that most of the Performance Requirements are only required “where appropriate” or only apply to specific building classifications and uses. This being said all of the NCC Performance Clauses needs to be read.

5.1 Egress Performance Requirements

Alert: *The Objectives and Functional Statements provide guidance as to the intent and interpretation of the Performance Requirements. They are provided as explanatory information in the Guide to NCC Volume One.*

The Objectives, Functional Statements and Performance Requirements in the NCC that are relevant to using a suitably designed evacuation lift are as follows.

Objective - DO1

“The *Objective* of this Section is to—

- (a) provide, as far as is reasonable, people with safe, equitable and dignified access to-
 - (i) a building; and
 - (ii) the services and facilities within a building; and
- (b) safeguard occupants from illness or injury while evacuating in an emergency.”

This Objective could include using a suitably designed evacuation lift system.

Functional Statement - DF2

“A building is to be provided with means of evacuation which allow occupants time to evacuate safely without being overcome by the effects of an emergency.”

This Functional Statement could include using a suitably designed evacuation lift system.

5.1.1 Performance Requirements - DP4, DP5, DP6 (for exits) and DP7 (for lifts)

DP4

Exits must be provided from a building to allow occupants to evacuate safely, with their number, location and dimensions being appropriate to—

- (a) the travel distance; and
- (b) the number, mobility and other characteristics of occupants; and
- (c) the function or use of the building; and
- (d) the height of the building; and
- (e) whether the *exit* is from above or below ground level.

DP5

To protect evacuating occupants from a fire in the building *exits* must be fire-isolated, to the degree necessary, appropriate to—

- (a) the number of *storeys* connected by the *exits*; and
- (b) the *fire safety system* installed in the building; and
- (c) the function or use of the building; and
- (d) the number of *storeys* passed through by the *exits*; and
- (e) *fire brigade* intervention.

DP6

So that occupants can safely evacuate the building, paths of travel to *exits* must have dimensions appropriate to—

- (a) the number, mobility and other characteristics of occupants; and
- (b) the function or use of the building.

Performance Requirements DP4, DP5 and DP6 are about exits and make no mention of using lifts to supplement egress. Therefore, lifts should not be a consideration when determining compliance with the Performance Requirement for exits. Any Performance Solution for exits needs to be based on the considerations listed in these clauses.

DP7

Where a lift is intended to be used in addition to the *required exits* to assist occupants to evacuate a building safely, the type, number, location, and fire-isolation of the passenger lift must be appropriate to-

- (a) the travel distance to the lift; and
- (b) the number, mobility and other characteristics of occupants; and
- (c) the function or use of the building; and
- (d) the number of *storeys* connected by the lift; and

- (e) the *fire safety system* installed in the building; and
- (f) the waiting time, travel time and capacity of the lift; and
- (g) the reliability and availability of the lift; and
- (h) the emergency procedures for the building.

This Performance Requirement requires that where a lift is to be used to supplement other exit provisions the design needs to be appropriate with respect to a number of considerations. It is important to note that installing an evacuation lift is not mandatory but if a decision is made to install one or more, DP7 becomes mandatory. The clause starts with “Where a lift is intended to be used....”.

The installation has to be safe, of a suitable type, of sufficient number, suitably located and fire-isolated. As in performance clauses DP4, DP5 and DP6, smoke is not specifically mentioned in DP7 although some stakeholders feel that it should. The approach taken is that smoke is a product of the fire from which isolation is needed. Part E2 in Volume One of the NCC is about smoke hazard management. Another aspect that some stakeholders feel should be highlighted is the need to facilitate fire brigade intervention. Both of these aspects are important and should be considered for inclusion in DP7 in the future.

For (a), people needing to use a lift should not travel excessive distances. The distances should be comparable to the distances travelled to an exit.

For (b), people needing to use a lift would include those with varying types of disabilities, health conditions and potentially age demographics such as children and the elderly.

For (c), the designer will need to consider the function and use of the building. Each has its unique challenges for people with disabilities or mobility restrictions resulting in people moving slowly. For example, in a hospital or aged care residence there may also be a need to move patients in beds.

For (d), there needs to be special consideration for high-rise buildings where it may not be practical for most people to use the fire isolated exit stairways. Even low-rise buildings will have barriers to evacuation for those people with a disability. Essentially there is a relationship between the height of the building and the number of people needing to use a lift.

For (e), the fire safety systems, including the smoke hazard management, need to be considered. Particularly the protection of the lift landings, lift shaft, lift machinery area, lift power supply and also the communication and warning systems. Some stakeholders are of the view that to use a lift for evacuation, the building needs to be sprinkled. This may well be the solution in most cases but it is not in keeping with the NCC's performance-based approach for a Performance Requirement to mandate a solution. If it did, it would effectively be a DtS Solution.

Note that even EP1.4 for an automatic fire suppression system only says "to the degree necessary" and it is DtS Clause E1.5 of Volume One that details where such systems must be installed.

For (f), waiting time for a lift may increase the time taken to evacuate a particular storey. However, lift travel time may shorten the time to evacuate the building. There also needs to be sufficient space (including space to manoeuvre wheelchairs) at any lift landing with a sufficient number of lifts to be available to evacuate those needing assistance from a hazardous area in a reasonable time. This includes an assessment of the number of people likely to use the lifts. For example, the size of landings on levels reserved for people using wheelchairs at theatres and sporting venues where the numbers will be greater than elsewhere.

For (g), the engineering systems (machinery, electrics, controls etc.) and the safety systems of the lift need to be reliable and the designer needs to consider whether the lift may be out of service for maintenance or being used by the emergency services personnel, particularly if it is also an emergency lift. Like any other requirement of the NCC, the building law in the States and Territories requires that what is initially installed is maintained at that performance level for the life of the building. Some States also highlight what they consider essential services that need a specifically defined maintenance regime. Evacuation lifts should be part of such a regime.

For (h), the emergency procedures for the building, different stakeholders will read this differently. "Emergency procedures" is not a defined term in the NCC. In a performance clause it should be interpreted in the broadest sense and include emergency planning, emergency plans and the procedures for executing those plans and procedures.

As mentioned earlier, all of these considerations need to be addressed. Some stakeholders favoured including "fire brigade intervention" as a consideration. It exists in DP5 to protect occupants of exits (including the rescue service personnel). Lift lobbies or refuges are not exits but on paths of travel to exits so fire brigade intervention consideration may not be much different from other areas on a storey. The lift shaft itself

is covered by the fire-resistance considerations of Performance Requirement CP2 in Volume One of the NCC.

In summary, a building could now contain three types of lifts or lifting devices, namely-

- Passenger lifts, goods lifts and devices for access and non-emergency egress.
- Emergency lifts.
- Evacuation lifts.

In practice, particularly in a small building, all three may be the same lift; that is, the one lift may fulfil all three functions provided it has all the required provisions. The lift would be a passenger lift under normal circumstances but in an emergency would be used for evacuation. Once the emergency services personnel are on site it would probably be taken over by them to complete evacuation and attack the fire.

5.2 Smoke Hazard Performance Requirements

Alert:

The Objectives and Functional Statements provide guidance as to the intent and interpretation of the Performance Requirements. They are provided as explanatory information in the Guide to NCC Volume One.

It is important to consider the Objective of the Performance Requirement for smoke hazard management:

EO2

“The *Objective* of this Part is to—

- (a) safeguard occupants from illness or injury by warning them of a fire so that they may safely evacuate; and
- (b) safeguard occupants from illness or injury while evacuating during a fire.”

This Objective could include using a suitably designed evacuation lift system.

EF2.1

“A building is to be provided with safeguards so that—

- (c) occupants are warned of a fire in the building so that they may safely evacuate; and
- (d) occupants have time to safely evacuate before the environment in any *evacuation route* becomes untenable from the effects of fire.”

This Functional Statement could include using a suitably designed evacuation lift system.

EP2.2

- (a) In the event of a fire in a building the conditions in any *evacuation route* must be maintained for the period of time occupants take to evacuate the part of the building so that—
 - (i) the temperature will not endanger human life; and
 - (ii) the level of visibility will enable the *evacuation route* to be determined; and
 - (ii) the level of toxicity will not endanger human life.
- (b) The period of time occupants take to evacuate referred to in (a) must be appropriate to—
 - (i) the number, mobility and other characteristics of the occupants; and
 - (ii) the function or use of the building; and
 - (iii) the travel distance and other characteristics of the building; and
 - (iv) the *fire load*; and
 - (v) the potential *fire intensity*; and
 - (vi) the *fire hazard*; and
 - (vii) any active *fire safety systems* installed in the building; and
 - (viii) *fire brigade* intervention.

A suitably designed evacuation lift and shaft needs to meet this Performance Requirement for fire-isolation and smoke management. Note that an evacuation route is defined as “the continuous path of travel (including exits, public corridors and the like) from any part of a building, including within a sole-occupancy unit in a Class 2 or 3 building or Class 4 part, to a safe place.”

5.3 Lift Installation Performance Requirements

Alert:

The Objectives and Functional Statements provide guidance as to the intent and interpretation of the Performance Requirements. They are provided as explanatory information in the Guide to NCC Volume One.

It is important to consider the Objective of the Performance Requirements for lift installations EP3.1, EP3.2, and EP3.3:

EO3

“The *Objective* of this Part is to—

- (e) facilitate the safe movement of occupants; and
- (f) facilitate access for emergency services personnel to carry out emergency procedures and assist in the evacuation of occupants.”

This Objective could apply to occupants using a lift for evacuation interpreting “safe movement of occupants” to include in an emergency. The phrase “assist in the evacuation of occupants” for the emergency services personnel does not prevent occupants evacuating independently up until the emergency services personnel take control.

EF3.1

“Where a passenger lift is provided, it is to facilitate safe and easy—

- (g) movement for occupants with a disability; and
- (h) evacuation of occupants, who due to illness or injury need stretcher assistance.”

Like the Objective, this Functional Statement could also apply to occupants using a suitable evacuation lift.

EF3.2

“A building is to be provided with one or more passenger lifts to facilitate—

the safe access for emergency services personnel; and

safe and easy evacuation of occupants who due to illness, injury or disability cannot use exit stairways in the event of an emergency.

This Functional Statement is about lifts being suitable for use by emergency services personnel.

EF3.3

“A building having a passenger lift is to be provided with measures to alert occupants about the use of the lift in an emergency.”

This Functional Statement applies to all lifts.

EP3.1

Stretcher facilities must be provided, to the degree necessary-

- (a) in at least one emergency lift *required* by EP3.2; or
- (b) where an emergency lift is not *required* and a passenger lift is provided, in at least one lift, to serve each storey in the building served by the passenger lift.”

This Performance Requirement requires at least one lift to be suitable to accommodate a stretcher.

EP 3.2

One or more passenger lifts fitted as emergency lifts to serve each storey served by the lifts in a building must be installed to facilitate the activities of the *fire brigade* and other emergency services personnel.

This Performance Requirement applies to a lift that is to be suitable for use by the emergency services personnel.

EP3.3

Signs or other means must be provided to alert occupants about the use of a lift during an emergency.

This Performance Requirement applies to all lifts.

5.4 Egress DtS Provisions

There are no DtS Provisions for an evacuation lift and services however in developing a Performance Solution for using lifts for evacuation the DtS Provisions are still important because:

- The Performance Solution may not be a total alternative but may incorporate some existing DtS Provisions for egress.
- The DtS Provisions for egress that do exist provide a means of quantifying or describing the acceptable level of protection or type of measures needed for evacuation.

5.5 Provision of a fire control centre

A fire control centre is a dedicated room with specific requirements. The DtS Provisions of E1.8 in Volume One of the NCC require a fire control centre in any building with an effective height of more than 25 metres. It also is required in a Class 6, 7, 8, or 9 building with a total floor area of more than 18,000 m³. Specification E1.8 in Volume One of the NCC describes the construction and content of required fire control centres.

The NCC requires that a fire control centre contain controls, panels, telephones, furniture, equipment and the like associated with the required fire services in the building that is not to be used for any purpose other than the control of-

- fire-fighting activities; and
- other measures concerning the occupant safety or security.

Ideally, this centre would normally be located in the vicinity of the primary fire service access point to the building.

ISO/TR 25743: 2010(E) and the International Building Code (IBC) 2012 also refer to the need for an emergency command centre while the draft Guidelines for 'Designing Fire Safety in Very Tall Buildings' by the Society of Fire Protection Engineers refers to the control of safety systems being generally from a centralised, staffed control room.

5.6 Evacuation strategy for DtS Provisions

The current NCC does not contain specific DtS Provisions for lifts that people may use in an emergency to exit the building. The DtS egress provisions are based on using exit stairways, exit ramps, exit passageways and horizontal exits. In addition there are life support systems including fire control and suppression, smoke hazard management, emergency lighting, exit signs and warning systems.

The current DtS Provisions for lifts require a fire service recall operation switch to be located on the landing of the nominated floor (usually the one giving access to the street) for the emergency services personnel or the Warden with the authority to recall lifts to that level. That switch takes the lifts out of normal service. When the emergency services personnel arrive the lifts are waiting for them to take control and operate one or more lifts using the lift car fire service drive control switch.

The DtS Provision is for the recall operation switch to be manual; however, in some jurisdictions the lift recall switching may be automatic on any alarm. To operate automatically the ancillary control facility on the fire panel can send a signal to the lift's control system to initiate fire service recall.

Keeping conventional passenger lifts in operation during an evacuation is not recommended in AS 4083, 'Planning for emergencies-Health care facilities' (a standard that provides guidance on evacuation). However, Wardens have the means to use the conventional passenger lifts to get people with a disability out of the building on the initial alert tone if the lifts, lift shafts and lobbies are suitably designed and it is decided that it is safe to do so. For example, there may be multiple sets of lifts that are some distance apart and the Wardens may be aware of where the fire has occurred. While this may be a current practice in some jurisdictions, it is not recommended where there is a single bank of lifts unless the building has a suitably designed evacuation lift system as discussed in Sections 5 and 6 of this Handbook. The Emergency Plan for the building should say when this option exists.

Where lifts are proposed for emergency evacuation, the strategy, planning, procedures, documentation, training and maintenance provisions would need to be significantly different to those of a building approved with DtS Provisions. Those responsible for these actions need to be made aware of the difference.

6 Solutions That Include Using Lifts

6.1 Development of a holistic, integrated approach

A key objective in an emergency is to move occupants away from a hazard, and eventually to a “safe place” as defined in the NCC—including out of the building. The concept of a safe place is a particularly important one for high-rise or large buildings because escape to a safe place as defined in the NCC, could take a considerable amount of time. The NCC definition of a safe place is:

Safe place means—

- (a) a place of safety within a building—
 - (i) which is not under threat from a fire; and
 - (ii) from which people must be able to safely disperse after escaping the effects of an emergency to a road or *open space*; or
- (b) a road or *open space*.

Safe places include fire-isolated exit stairways, refuges or an adjacent fire compartment through a horizontal exit. All are likely to be safer than the hazardous area initially.

The DtS Provisions detail the systems required where lifts are not used for occupant evacuation (except where assisted by emergency services personnel). There are no such details for a Performance Solution where suitable lifts may be used for evacuation. One reason for this is that there are many different scenarios that are likely to need different and unique solutions.

The solution is not simply a matter of designing and constructing technical provisions for the lifts, lift shafts, lift landings and the various fire alarm and fire suppressions systems. The success of the solution will also depend on the management planning, the management systems and having the personnel provided and trained to assist with an evacuation. This means an integrated approach of engineering systems and management systems. For example, if holding some people in lift lobbies and directing others to fire-isolated stairways is part of the solution, the lobbies will need to be protected and have well trained Wardens to manage and direct people as necessary.

The management systems have many components that need to be integrated into the solution. Important factors include the monitoring of, and communicating with, all

occupants, including those with a hearing or vision impairment. Decision making and permitting of an evacuation lift to respond to calls will also need to be considered.

6.2 Egress strategies

Whether a lift can be used to assist evacuation will depend upon a number of factors, including:

- The evacuation strategy proposed.
- The management plan and the management needed to achieve the intended outcome including ongoing maintenance and testing.
- The functions performed in the building and the level of awareness of the building occupants.
- The life safety systems in the building including at lift landings, in the lifts and in the lift shafts.
- The enhanced performance of the lift and supporting services including their availability and calculated reliability over the life of the building.
- The human risk involved in implementing the strategy; being risk to occupants and risk to potential rescuers.
- The probability and consequences of unintended consequences.
- The response of the emergency services personnel.

Internationally there have been five traditional strategies for evacuating the occupants of a building:

1. Simultaneous full evacuation.
2. Phased full evacuation.
3. Phased partial evacuation.
4. Protect-in-place for everybody immediately affected (i.e. a safe place).
5. Protect-in-place for those unable to use the egress provisions (i.e. refuges).

ISO/TR 25743: 2010(E) advises that it may be better to have no lifts in service and so encourage people to use the stairways rather than to have too few lifts in service, leading to long waiting times. This would mean that some provision would need to be made to protect people unable to use the stairways until such time as they can be rescued.

In a sprinkler protected building it is more likely that if the sprinklers act as intended in a fire, occupants would be impacted by exposure to smoke rather than fire. In any case,

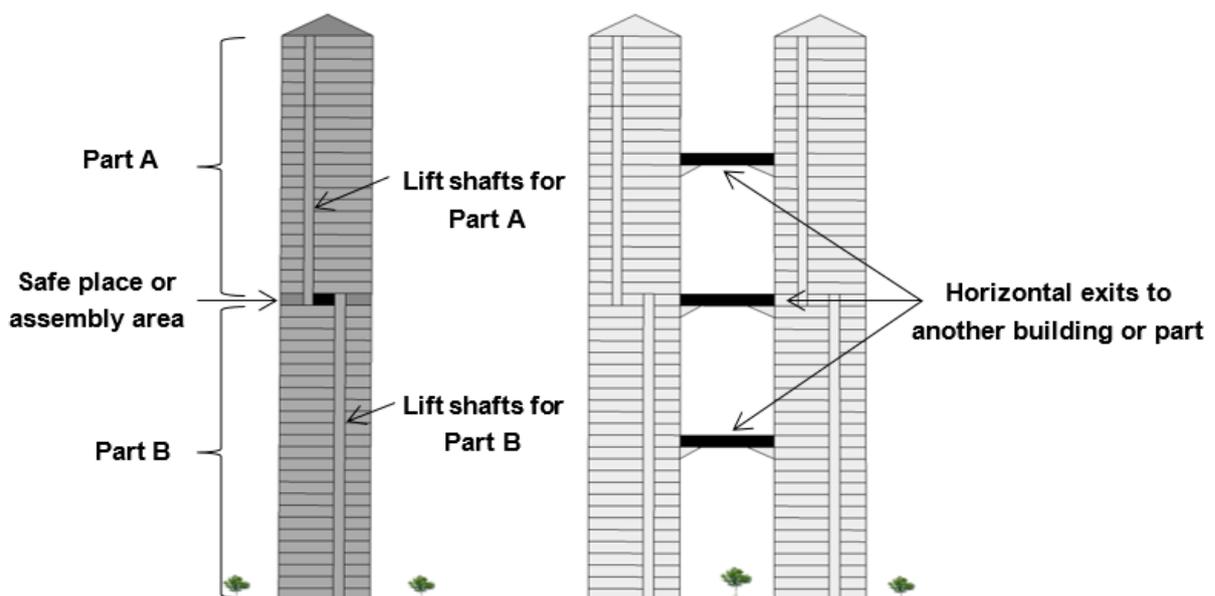
researchers agree that if lifts are to be used for evacuation, fire and smoke free places with direct access to the lifts are needed. Whether they are refuges, lobbies or larger areas will depend on the type of building occupancy and the potential number of occupants that need to be safely located.

Some storeys of the building may have different classifications and different uses, effectively separate “buildings”, and so have separate systems which may need an additional layer of communication and alarms. The overriding of security systems will also need to be considered.

Evacuation could mean from the building or from a part of the building. This could be from multiple storeys with some storeys above and below ground. The building may have additional fire compartmentation at some levels. Again this would mean that the building is effectively a series of buildings on top of each other with separate fire safety systems including separate smoke control for each part. This may also coincide with the configuration of the areas served by lift shafts with occupants needing to change lifts at intermediate transfer levels.

The method of evacuation may depend on the source of the alarm and whether an actual fire has been confirmed. The time of day can also play a role in choosing how to notify and evacuate the occupants. If an alarm occurs during times when there are few occupants in the building the person responsible may instigate a complete evacuation of the building.

Figure 6.1 Compartmentation, safe places including horizontal exits



The time to evacuate people from the top storey to the street exit is likely to be very significant in a high-rise building; so much so that the cause of the emergency could overwhelm the slower evacuees. For this reason, partial evacuation is likely to be preferred.

If a partial evacuation is undertaken, the person responsible will need to be familiar with and consider the independence of the following:

- zones of smoke control in the building;
- the different zones of the fire alarm system;
- the different zones for the voice communication system;
- the configuration of lift shafts and the floors they served. In high-rise buildings, there will likely be several banks of lifts including express lifts that serve different levels.

When considering the use of lifts for evacuation, the scenarios are-

- the lifts only being for people unable to use the fire isolated stairways while others continue to use the fire isolated stairways; or
- the lifts being available for anybody, supplementing fire isolated stairways and other exits.

These two scenarios need to be considered separately. While the design of the evacuation lifts and fire safety systems would be similar, consideration of the signage, management procedures, passenger handling capacity and consequently the number of lifts would be different. For example, if the lifts are primarily for people unable to use the exit stairways, then a Warden would need to direct people and control the use of the lift. This may have its difficulties where there is a large lobby area serving several lifts making the Warden's role difficult. With the possibility of fire or smoke on more than one floor, Floor or Area Wardens would need to be informed of the situation on other floors before deciding on the priority.

The decision on who can and who cannot use a lift will require strong management control including the need to overcome panic and people's perception of what constitutes the quickest means of escape.

The American Society of Mechanical Engineers recommends getting people with a disability out of the building on the initial alert tone if the lift system is suitably designed. This would be similar to the practice of boarding onto aircraft those people needing assistance or families with young children. However, this is recommended only in

buildings that have a suitably designed emergency lift system, appropriately trained Wardens and individual PEEPs for regular occupants.

The main thing in favour of using suitably designed lift systems, particularly for a person who because of their condition may feel vulnerable, is that they are familiar with the route to the lifts whereas other routes, say to stairways, may be unfamiliar.

Throughout this document lift landings have been referred to for consistency with lift terminology. For fire safety matters, the landings will need to be an appropriately protected lobby, refuge (because of the need for direct access to a lift) or external to the building.

6.3 Warden and emergency services personnel

6.3.1 Warden's role where lifts are to be used

If lifts are to be available for use during an evacuation Wardens are likely to be an essential part of managing the evacuation strategy. Their roles are described in the guidance standards AS 3745 and AS 4083 but if lifts are to be used, this also needs to be documented in the building's emergency plan. AS 4083 was prepared on the basis of building occupants not using lifts during evacuation and needs to be read in that context.

Where lifts are to be used to only evacuate people needing assistance, a Warden is likely to be needed at the lift landings to direct others to the stairways. In addition, where only one lift is to be used for people needing assistance that lift could be manually controlled by a Warden until such time as the emergency services personnel arrive or the lift becomes untenable.

All Wardens should be able to be in continual communication with a fire control centre where one exists. Where a high-rise building has fire-isolated safe places the Wardens would need to direct people to those areas in accordance with the emergency plan.

Determining if the evacuation of the building has been completed is vital. The evacuation plan needs to consider how it will be determined that a given storey, including any refuge, is clear of people; usually by the Floor or Area Warden.

Lift systems are not capable of determining if a storey has been cleared of people and until this is known the evacuation lift should remain in service as long as possible. The lift could be required to wait at the landing with its doors open until a car button is pressed or a load detected entering the lift. However, this could reduce the evacuation capacity for other levels.

People may also need to be directed to leave an evacuation lift on a safe storey. This would then free-up the lift to quickly return to collect more people. As there may be some reluctance to leave the lift, Warden control would again be essential. If a safe storey was to be utilised then it would need to be a non-secure floor or have any security provisions over-ridden.

Regular occupants who have a disability should have a PEEP. However, in many buildings short-term employees or visitors may not have a PEEP or be familiar with the building and would be reliant on wardens directing them.

Another reason why a Warden is essential is where people wish to travel up a building rather than down or out. For example to get valuables or rescue friends; possibly children who are in a high-level day-care facility.

6.3.2 Emergency services role

The response time for emergency services to arrive at the building and then to reach the storey under threat will be considerably more for a high-rise building than a low-rise one.

It may not be practical to totally evacuate a building. Under Warden direction, occupants would commence a staged evacuation with the emergency services personnel taking control when they arrive.

Once on the scene, the emergency services personnel would then determine where the fire is and take control of at least one lift (the emergency lift). Usually using the lift to position themselves just below the fire level. This will limit the number of lifts available for evacuation.

The priority of further evacuation of any remaining people needing assistance, or fire attack, is normally assessed on-site by the emergency services personnel and depends upon the circumstances. The emergency services personnel would give priority to assisting people who are not able to evacuate including any people trapped in a lift.

Fire fighting would most likely be from the safety of a fire exit (fire-isolated exit stairway) with a station being established a storey or two below the fire storey. The emergency services personnel would then use one or more exit stairways, possibly blocking them. So for evacuation to continue it may involve redirecting the evacuees to another exit stairway.

If lifts are to be used during evacuation, there is the possibility that some people may become trapped in lifts or are still waiting on landings for lifts to arrive. That information

needs to be available at the fire control centre. There should also be clear instructions for the emergency services personnel on where and how to get into the lift through landings and the lift shaft.

Lift ceiling trap doors are no longer mandatory as part of a DtS Solution. When they are provided, they are usually locked to protect lift occupants. The emergency services personnel will need information readily available on 'lift location', 'where can they access the lift shaft' and 'how do they to gain access to the lift in order to manage a rescue'.

Considering the various entrances to buildings (e.g. retail entrance, office entrance, hotel entrance, residential entrance, etc.) it may be necessary to have several fire service response points, each with the means to direct rescue and fire-fighting operations.

6.4 The design team

If the Performance Solution involves the use of lifts for evacuation, the fire safety engineer—or any single discipline professional—should not produce the strategy, the Fire Engineering Brief (FEB), or the building design, in isolation. Refer to the International Fire Engineering Guidelines for details on an FEB.

There needs to be a multi-discipline design approach, with the team including a fire safety engineer, a mechanical services engineer, a lift engineer, a NCC expert, an emergency planning expert and an access consultant. Early in the design phase for a new building, the design team should jointly produce a strategy document that would be both part of the documentary evidence for the Performance Solution and also inform the emergency plan. The designers will also need to liaise with the approval authority and obtain advice from the relevant fire service.

As for any performance-based solution, the design report should then demonstrate how the proposed design and proposed systems meet the Performance Requirements, but these are expressed in qualitative terms. It is critical for a building certifier that appropriate performance criteria, including the availability and reliability of life safety systems, be quantified and confirmed along with an appropriate Assessment Method or Verification Method.

Consideration should include:

- the number of occupants;
- the building's configuration;

- the integrated operation of all systems;
- the integrity of passive provisions;
- the operation and reliability of active systems including communication systems, alarms, sprinklers, hydrants and hose reel systems, smoke management systems, lift operation systems, power supplies;
- the management procedures to be in place and the likely response from emergency rescue services.

In developing a Performance Solution the designers need to consider a range of matters that are likely to be unique to the particular building and its use, as well as the holistic strategy proposed.

Due diligence should be applied where the solution involves changes to the control software of components such as the lift management algorithms. If changes are proposed, a lift controls expert will also need to be part of the design team with the resulting changes thoroughly tested. Responsibility for such changes would need to be resolved with the lift installer.

Where suitable lifts are to be used by all building occupants, a traffic study should be carried out as part of the design. This would apply to a high-rise building if full evacuation is proposed or to a hospital (or aged-care facility) where there would be a high proportion of people needing assistance. A traffic study may not be necessary if management practices were in place to limit lift use to people with a disability.

6.5 Design considerations

Prior to the development of any proposal to incorporate lifts into the life safety system of a building, the limitations of the lift systems and their associated control equipment need to be fully understood and addressed. The lift industry has identified the functions that can and cannot typically be performed by a lift. Such functions are outlined below and should be addressed through consultation with the lift designer and manufacturer as part of the analysis of any Performance Solution.

6.5.1 Understanding the lift's capabilities

For the development of a Performance Solution using lifts to supplement egress, the life safety and cost impacts of the lift systems and their associated control equipment needs to be understood. The lift industry has identified the following as a basis for consideration by the design team and the lift manufacturer.

Functions that lifts systems can typically perform are as follows:

- Carry their rated loads at contract speed.
- Run from bottom to top floor in a prescribed time.
- Communicate with persons outside the lift for assistance.
- Provide emergency lighting in a lift car for a limited period of time in the event of a power failure.
- Bypass a floor if fully loaded.
- Know when to open or close doors.
- Stop doors closing on a person.
- Facilitate special fire services control provided the keys are available.
- Bypass security systems when on fire service control.
- Provide information to a building management system as to a lift's location.

Functions that lifts cannot typically perform are as follows:

- Run when overloaded.
- Run when any door is open or has a faulty contact or lock.
- Run if doors are distorted by fire.
- Run if water is in the pit above a certain level.
- Run if safety gear has activated.
- Run if there is insufficient power available or the power is of poor quality.
- Run if door damage affects locks at any one landing.
- Run if the machine room temperature is excessive.
- Run if the lift is under repair.
- Decide who should use the lift.

6.5.2 Occupant awareness of using lifts for evacuation

High-rise buildings are becoming more common accommodating large numbers of people, some with occupancy levels reaching into the many thousands. They are increasingly complex in their design and diverse in their access and egress strategies.

Providing building occupants with accurate information about the situation increases their ability to make more appropriate decisions for their own safety. Threats to an individual's safety can be either real or perceived. The occupants' perceptions are developed based on available information. In an emergency situation, occupants will

make decisions about how best to provide for their own safety based on their perceptions of the situation. In a high-rise building, if those perceptions are not accurate, the decisions may be detrimental to their safety.

Awareness of one's surroundings and whether the situation has rendered part or all of those surroundings unusable for evacuation is critical. This information is needed by high-rise building occupants in order to make appropriate decisions during an emergency. Not being aware of the situation or of one's surroundings can be catastrophic in the event that a very large building needs to be evacuated.

Historically, building occupants have been directed not to use lifts in a fire emergency or for evacuation. As technologies have improved the design sector is increasingly looking to suitable lifts to reduce the amount of time for evacuation. In particular where people with a mobility condition cannot use the exit stairway or full building evacuations may be needed. While conducting exercises that incorporate all the evacuation systems will help the building occupants to understand how those systems can be used, there will inevitably be occupants in the building who were not present for the exercises or are visitors. Guidance on the training of these various groups is covered in AS 3745.

While some studies have shown that most people behave calmly in an emergency, if you tell someone that they should evacuate but they then have to wait a considerable period of time for a lift then they may become frustrated and start acting in a less rational manner.

Performance Solutions may vary depending upon the building's size and use, so people entering need to be made aware of the unique features of that building. Useful information at the time of an emergency that can be communicated to occupants of buildings includes:

- the location of the fire incident;
- whether the incident has disabled any of the building systems;
- where the lifts are located; and
- the movement of the lifts.

As a building may only have two exit stairways, it would be important to know if one of those exit stairways is unusable for egress. This could be because of the location of the fire or because the emergency services personnel are using that exit stairway.

6.5.3 The function and use of the building

The function and use of the building is an important consideration both for the condition of the people and also their familiarity with the building. In places of employment occupants will be trained in how to react in an emergency and the people will be very familiar with the egress routes. Visitors will be less familiar with egress routes but are likely to be assisted by the hosts.

In hospitals or aged-care buildings there will be a much greater number of people needing assistance to evacuate—including occupants who may be bedridden—but these buildings are also designed with additional fire safety features. Often horizontal exits that lead to a safer part and/or staff trained in emergency procedures.

In certain public buildings, such as museums and galleries, there may be groups of people with a disability or groups needing supervision (such as school children visiting the building). If this is the case then it is likely that the number of people with disabilities is significantly higher than the national average. Therefore the design capacity for lifts for evacuation should consider different scenarios rather than just considering national statistical data. The number of Wardens may also need to be increased under these circumstances.

6.5.4 The number of storeys

The trend to use lifts to assist egress has had the two following causes prompting it:

- The need for equitable treatment for people needing assistance.
- The increasing height of buildings with the subsequent increase in evacuation times.

The time to evacuate people from the top storey of a high-rise building to the street exit is likely to be very significant, so much so that the cause of the emergency could overwhelm the evacuees. For this reason, partial evacuation is likely to be considered provided the building has suitable systems to reduce the spread of fire and smoke to the non-fire compartments.

Designers and developers have also had the problem of maintaining space efficiency as buildings get taller. The space needed for lifts, exit stairways that cater for the greater number of people, and service ducts increase as a building gets taller. Therefore there may be design pressure to remove one exit stairway or avoid having lobbies or refuges. Using lifts to supplement evacuation should not be a reason for removing one exit stairway.

6.5.5 The fire safety systems installed in the building

The fire safety systems in a building need to be appropriate to the design, occupancy classification and use of the building.

To comply with the NCC DtS Provisions all buildings over 25 metres must have a sprinkler system and some large or special buildings must have a sprinkler system irrespective of height. Where refuges are to be provided, the building should have a sprinkler system because of the potentially extended period of time that people may be in the refuge.

There is a view amongst many key stakeholders, including AFAC, FPAA and the Society of Fire Safety (SFS), that all buildings should have sprinklers if lifts are to be used for egress because of the evacuation times. It is also their view that partial installation of sprinkler systems is often ineffective and may create a hazard for fire brigade intervention. These are not fundamental Performance Requirements of the NCC so remain a matter for the design team and the building certifier to consider in the Performance Solution.

As well as sprinklers, smoke hazard management systems (i.e. detectors, alarms and smoke control air-handling systems) are required by the NCC in particular situations. They are required in evacuation routes such as fire-isolated exit stairways, passageways and ramps.

In order to maintain appropriate levels of safety careful consideration should be given to the appropriate fire safety systems to be installed. Items such as sprinkler systems, fire protected lift landings, stair and lifts pressurisation, zone pressurisation, warning systems and improved detection all need to be considered.

Alarms and smoke management systems would also need to be considered for lift landings and lift shafts. These would be grouped separately from the rest of the building and from other banks of lifts.

6.5.6 The decision making ability

A relatively sophisticated exchange of information is needed between the Wardens, the various sensors for detecting malfunctions or adverse conditions, and the lift control system. Critical decisions could then be made by the responsible person in a fire control centre. In this way, an automatic system or the responsible person would be able to prioritise which storeys are to be evacuated first. This would be based on the threat, the number of persons needing evacuation, their condition, the number of lifts available and in which part of the building the threat is most hazardous.

Electronic information exchange would require special and complex equipment and software which may not exist for all lift suppliers and the development of such may be cost prohibitive for an individual solution.

6.5.7 Travel distances to the lifts

The travel distance to an evacuation lift will depend on the geometry and use of the building and on the mobility of the people needing to use the lift. NCC travel distances provisions are based on distances to exits so the distance to lifts also need to be considered. People needing to use a lift are more likely to be people with a disability or a health condition where their path of travel to the lift may be longer, via a lobby or a refuge. Multiple access points into a protected lobby or multiple lobbies associated with lifts need to be considered. Any security locks need to be automatically released.

6.5.8 The lift configuration

The number of occupants on each storey that are predicted to use the lifts during evacuation (with an appropriate safety margin) should be reflected in the number, capacity and travel times of the lifts including the likely waiting times. This will also depend upon the number of lifts in service and available for building occupants to use.

The travel time will depend upon the lift configuration which may take many forms. The building may have a single-rise lift system, with the lifts stopping at all storeys, a multiple-rise lifts system where passengers ride one lift to an intermediate transfer level and then change to another lift, an express lift, or a combination of the three.

For high-rise buildings, the use of intermediate transfer levels and multiple lift shafts are likely. People may leave their lift on an intermediate storey and take another lift because of the limit of a lift's travel. Somewhere around 80 to 100 storeys are likely to be the limit of a lift's travel. With this configuration the building can be separated into vertical evacuation zones according to the lift and stair arrangements. Lifts serving the zone with a fire could operate differently to those not serving that zone. Express lifts located in fire and smoke-isolated separate shafts could bypass fire levels and continue to operate.

A design consideration is whether, in an emergency, to have a dedicated lift for those who need assistance to egress—as is the practice in some countries—or whether to make all lifts available. Waiting times can be long if only one lift is made suitable while the cost of making all lifts and their support systems suitable, including the alternate power supply, may be considerable. A low-rise building may only have a single lift so it may need to be available only for people needing assistance.

The emergency plan and decision making needs to be tailored to the lift configuration. The number of occupants that are expected to use the lifts for evacuation should be reflected in the number, capacity and travel time of the lifts.

6.5.9 Lift handling capacity

The building designer will need to determine the number of people that need to be evacuated in the targeted evacuation time and of those people, how many are likely to use the exit stairway and how many will use the lifts. This will depend on the number of people in the building and may change from time to time depend on who's leasing the building and for what purpose. The lift engineers will need to calculate the number of trips needed to move those people in the targeted time. Studies indicate that people able to use stairways are less likely to wait on a crowded landing even if the lifts are supposed to evacuate all people.

The number of people physically needing the assistance of a lift to evacuate can be estimated by firstly using ABS data. Of the population some 0.6% of the population use a wheelchair, 1.6% have vision impairment, 2.5% of the population use a mobility aid, some 10.5% have a mobility disability while 20% report some form of a disability. A further 21% have reported a long term health condition. While there is Australian Bureau of Statistics data on percentages in the workforce, how many of these people use or work in the various types of buildings is more difficult to determine. It may be assumed that while the percentage with a mobility disability or using a mobility aid may not change as a building's height increases, the number of people with a health condition (such that they cannot travel many flights of stairs) will become more significant. This will also change with an ageing population.

Certain building types or areas within buildings have the potential to have a significantly greater number of occupants that have some form of mobility impairments compared to the national average. These include public buildings such as museums, galleries and sports arenas where groups containing a higher number of people with mobility impairments may visit. This needs to be taken into consideration when designing for the use of lifts for evacuation.

Where there is a high number of people needing assistance, full evacuation may not provide satisfactory evacuation times and partial evacuation may be the best strategy. The evacuation strategy proposed for the building should reflect the level of safety provided by the fire safety systems. Where these systems are designed to restrict the spread of fire and smoke to the area of the fire's origin then it may be better to limit the number of floors evacuated. This would maintain clear egress routes (exits, exit stairways, lifts) for occupants who are at greatest risk from the fire. Unless these people

are catered for using lifts, their use of exit stairways when moving slowly or even staying on the exit stairway landing, may increase evacuation times for all users.

Lifts need to be sized for the likely number of occupants and it should be assumed that some will be using wheelchairs. Therefore the size of the lift car should be suitable to accept a wheelchair whilst still providing room for a number of additional occupants. This will be the case if the lift is sized as an emergency lift.

Where a building has a bank of lifts, the availability of lifts for evacuation should assume that one lift may be out of service for maintenance or replacement and another lift may be reserved for, or taken over by, the emergency services personnel. This should be the basis of any traffic management study. Alternatives for buildings with few lifts are to arrange servicing out-of-hours, or commence evacuation of people needing assistance when the alert tone is sounded. For a building under 25 m, it should not send a lift to the nominated floor immediately but wait for the emergency services personnel to arrive and take it over manually.

Alarms that warn occupants when the lift's rated capacity is being approached, reached and exceeded need to be considered. The alarms cause the doors to remain open until the overloading is rectified. Some consideration could be given to an increase in capacity of components to 125% (without increasing the size of the lift) where the possibility of over-loading is high.

This aspect highlights the need for a Warden to be at each landing to control loading.

Loading and unloading times are often significantly longer than the lift travel time during a lift cycle. Designers need to take this into account when calculating the likely clearance times.

6.5.10 International Fire Engineering Guidelines (IFEG)

The IFEG identifies to the design team and the building industry at large, an acceptable framework by which stakeholders are included in the development and approval of a fire safety Performance Solutions. The framework is a methodology recognised by peak industry bodies including the ABCB, the SFS, the AFAC and the Australian Institute of Building Surveyors.

The IFEG recommends that for any fire engineering solution, the development of a fire engineering brief and a fire engineering report are paramount with all stakeholders being involved in preparing these documents. In particular, they need to be provided with the opportunity to identify and address all issues associated with the use of lifts

during egress. AFAC recommends that this framework be adopted in the design of lifts to be used during evacuation.

The IFEG recognises that fire brigade intervention is a significant design consideration when any fire safety Performance Solution is developed.

The IFEG is available on the ABCB website at www.abcb.gov.au

6.5.11 The availability and reliability of the lifts

Some specific considerations and analysis techniques are covered below but lift reliability, life support system reliability and lift availability are essential considerations. Where a goods lift is to be used, the management strategy would need to ensure that goods were not left in the lift or on the landings, and also that the lift was not isolated from use.

The lift's engineering equipment, power supply systems and life support systems, including the alarm and communication systems need to continue to work in the emergency. Life support includes the lift shaft's and landing's fresh air supply and smoke control pressurisation system.

6.6 Reliability and availability studies

System failures occur every day. Air-conditioning systems malfunction, power might be lost for a few minutes to a room or storey of a building, or a lift is taken out of service for maintenance. Usually the interruptions are brief, however, in a high-rise building; interruptions to such systems can have major impacts on the building's occupants. Scenarios need to be worked through initially and then sensitivity cases for failures need to be investigated.

Loss of a lift servicing the 100th storey of a building is more than a minor inconvenience, particularly if the lift is intended to be used as part of the emergency evacuation plan.

A lift used for evacuation needs to be reliable but any Performance Solution for using lifts needs to be practical, cost-effective, and not in advance of current practices and likely innovations overseas from where lifts are sourced. For example, lift controls are not built to a temperature specification and so may cease operation at 40°C and to require greater reliability may be cost prohibitive.

Typical studies include decision making and sensitivity, redundancy and uncertainty studies in some form. Typically they may include one or more of the following

depending upon the application as well as fault tree analysis, mean time between, or to, failure analysis, failure mode, effects, and criticality - redundancy analysis.

They all need to be tailored for the particular building as it will vary depending upon the characteristics and the building systems.

6.6.1 Cause-and-effect matrix

A cause and effect matrix or diagram (also called fishbone, herringbone, or Fishikawa) is a tool which is used to prioritise potential causes by examining their possible impacts. It shows the causes of a specific event and identifies potential factors causing an overall effect.

Each cause or reason for the condition is a source of variation with causes usually listed down the left side of the matrix and their effects across the top. Causes may be grouped into major categories. The relationship between the causes and effects may be ranked in terms of importance and an overall score calculated where the cause with the highest overall score is addressed first because of the greater impact.

6.6.2 Decision analysis

Decision analysis is a formal process to assist in determining the appropriate emergency action, the ‘pros’ and ‘cons’ and ‘yes’ and ‘no’ in a structured and logical way. It is usually presented as a decision chart or decision tree and is a useful means of better understanding what actions are needed and consequently what the emergency systems should provide. For guidance, ISO/TR 25743: 2010(E) provides a chart that includes the following typical risks and actions.

Table 6.1 Risk assessment

<i>Hazard</i>	<i>Risk</i>	<i>Proposed action</i>
Fire at lift landings	Passenger fatalities	Assessment on passing fire floors. Manual process required to assess risk
Fire at exit floor	Passenger entrapment and fatalities	Alternate exist floors required system detection
Water at landings	Passenger entrapment in lift with shorting of lock mechanisms	Lift shut-down and manual recall process engaged
Smoke levels at landings	Passenger affixation	Smoke detection and shut-down sequence

<i>Hazard</i>	<i>Risk</i>	<i>Proposed action</i>
Smoke levels in shaft	Passenger affixation	Smoke detection, shutdown and recommend alternative egress
Gas or biological attack on a floor	Passengers affixation	Gas detection systems and shut down
Explosion on a floor	Damaged lift shaft - unsafe operation	Method to assess damage and shutdown
Flooding of basement or exit floor	Passengers trapped in flooded car	Pit water detection
Power failure in the building	Passengers trapped in lift cars with no egress	Secondary power system designed to suit the lift requirements

6.6.3 Risk analysis

With all the potential engineering failures, the risk of using a lift for evacuation needs to be determined after considering the risks and likely effectiveness of alternatives.

A risk analysis is a risk management tool that enables the systematic evaluation of risks. This includes the magnitude or severity of a possible adverse consequence and the likelihood or probability of each consequence occurring. It asks “What could go wrong?”, “How likely is it to occur?” and “What would be the consequences?”

Risk assessment and management techniques can be helpful for emergency personnel in planning responses and managing fire operations. To make the best decision, an understanding of what mitigation measures are in the building, the availability of those systems within the building, and evacuation systems provided are crucial. Based on the type of information required for a range of possible events and scenarios, a risk-informed approach to response planning can help identify types of sensors, camera locations, communication and control equipment, and related resources which are to be installed in the building to help manage an emergency.

A risk analysis methodology specifically for lifts is ISO 14798:2009. “Lifts (elevators), escalators and moving walks -- Risk assessment and reduction methodology”. The purpose of this standard is to provide guidance on making decisions relevant to the safety of lifts during the design and construction. This includes the installation of the lift components and systems; developing generic procedures for the use, operation, testing, compliance verification, and servicing of lifts; and development of technical specifications and standards affecting the safety of lifts.

6.6.4 A Hazard and Operability (HAZOP) analysis

This is similar to a risk analysis as it is about asking questions on how each system or component will operate in all conceivable emergencies. It tests all items of equipment and systems focusing on their reliability and back-up by going through a series of “what-if” scenarios. Where software is making decisions it needs to be tested thoroughly and operate in a similar manner to a person making decisions in a fire control centre.

6.6.5 Reliability or availability analysis

A reliability or availability analysis uses a set of mathematical calculations to quantify the overall reliability of an item of plant, a system being in service when needed, or a back-up item or system being available. It combines the concepts of reliability and maintainability and gives the probability as a numeral of an item or system being available (not broken and not undergoing repair) when called upon for use.

How the level of reliability is set needs to be determined after considering the alternatives and their likely effectiveness.

6.6.6 Design report

The results from these studies need to be included in the design report.

7 Egress Lifts and Their Services

7.1 Type of lifts

This Handbook is directed at electric and electro-hydraulic passenger lifts but other types of lifts also deserve consideration.

A combined passenger and goods lift could be suitable provided it has all the features discussed in this Handbook. It is also accepted in the Premises Standard as a suitable lift for accessing a building. Management practices would need to be in place to ensure that the lifts are not used during normal occupancy hours for goods deliveries, or garbage removal, nor should they be taken out of action for delivery people or tradespeople to load or unload, or leave goods inside the lift.

A dedicated goods or garbage lift may not be suitable because of the higher likelihood of these practices taking place unsupervised, often by contractors who would not be familiar with the building's emergency evacuation plan.

In addition to an electric passenger lift or a electro-hydraulic passenger lift, there are also a range of specialised lifting devices used to enable people with a disability to access buildings. These are:

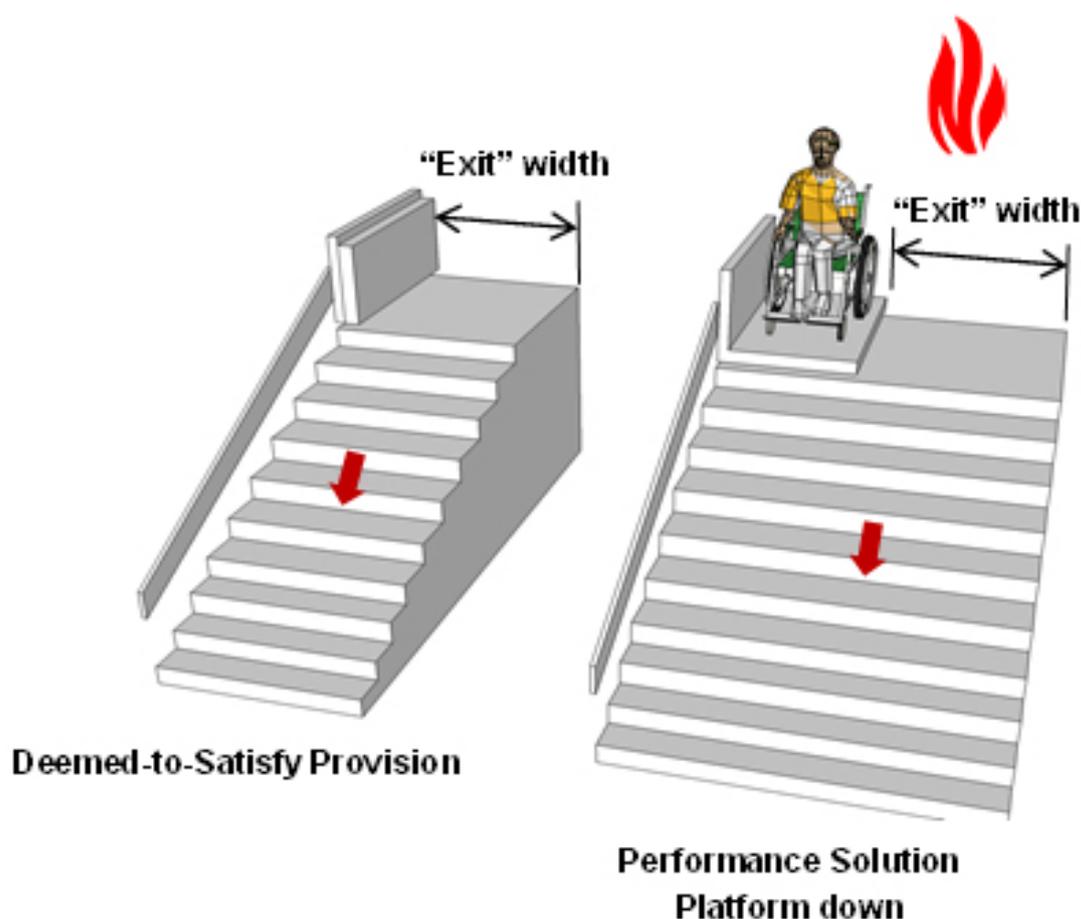
- A stairway platform lift
- An inclined lift
- A low-rise platform lift
- A low-rise, low-speed constant pressure lift
- A small-size low-speed automatic lift

Most of these specialised lifting devices have limitations on their use for access. The stairway platform lift may only travel two storeys, the low-rise platform lift may only travel up to 1 m, the low-rise, low-speed constant pressure lift may only travel up to 4 m (if enclosed) and the small-size low-speed automatic lift may only travel up to 12 m.

These access limitations mean that they are most likely to be used in low-rise buildings that may have less stringent NCC fire provisions. Any of these devices could be used for evacuation provided they have the features described in the following sections. However, a stairway platform lift is very slow, and not the preferred option of the disability sector (even for access). It is more likely to be used for a retro-fit in an existing building where another type of lift could result in unjustifiable hardship. Where these lifting devices are to be used, they would need a reliable power supply plus be capable of driving the device to the lower level in the event of mains power failure.

Figure 7.1, showing evacuation in the downwards direction, highlights that one of the NCC DtS Provisions for a stairway platform lift is that it does not encroach on the BCA minimum width of the stairway with the platform raised. Where it is proposed for use during an evacuation as part of a Performance Solution (and there were a significant number of people needing to use the stairway) the platform would need to not encroach on the DtS minimum width of the stairway with the platform lowered.

Figure 7.1 Exit width with a stairway platform lift



7.2 Lift landings

A landing is from where people enter or leave a lift and may be open to another space or enclosure forming a lobby. The size of the lobby will depend on whether the lifts are to be used by everybody for access and evacuation, or just by people needing assistance. For lifts to be used during evacuation an enclosed and protected lobby needs to be considered.

The International Building Code 2012 (USA) suggests that for full evacuation a lobby should be capable of holding 25% of the occupants of the storey. However, to cater for

just those people with a disability or needing assistance will mean significantly fewer people and may not involve a lobby but a refuge.

Although developers may not like to lose space to a protected landing or lobby, and people with a disability may not like the concept of a refuge, both are part of overseas codes where lifts are used to supplement evacuation.

Consideration needs to be given to the following provisions:

- Access to the lifts and the fire-isolated exit stairway without re-entering the fire affected area.
- Sufficient circulation and manoeuvring space as well as door clearance and hardware as if they were part of an accessible path of travel.
- Two-way communication.
- A method for maintaining a lift lobby clear of smoke for the duration of the evacuation period and the lift landing pressurised to a level comparable to the lift shaft to avoid doors jamming.
- Signage as to which lift is to be used for evacuation if it is not all lifts.
- Fire and smoke alarms for the landings to be separately circuited to the remainder of the building so that lifts are only taken out of action when a hazardous situation arises on the landing.
- Communication as to where the lift is at any time. This would enable those waiting to see the lifts progress, assist their decision making and help avoid panic. It may need to be via a Warden's intercom system as the lift industry advise that the destination controls in modern lifts render on-floor indication impractical.
- The landing area graded away from the lift shafts and drained so that water from the fire affected area does not enter the shaft.

Depending upon the differential pressures likely to be imposed on doors when the smoke management system is operating, power assisted door openers may be considered for the doors to the landing area. Even the doors from accessible hotel and motel rooms on the path of travel to the landing should consider power assistance. Australian Standard AS 1668.1 'The use of ventilation and airconditioning in buildings: Part 1 – Fire and smoke control in multi-compartment buildings' provides information on pressure differentials.

Historically there were concerns about lift call buttons failing in the closed position when exposed to the effects of fire, having potential to call a lift to a fire. This is not the case with modern controls. In any case, the detectors on a landing would have taken the lift out of service before such a condition could occur. It is imperative that a lift not be called

to a fire affected landing. Rather an alarm from such a landing should put all lifts serving that landing and in a common shaft, into a fire recall sequence.

7.2.1 The landing of the nominated floor

The landing of the nominated floor is a landing nominated by the fire authority for people to leave the building as part of the emergency evacuation plan. It is usually at or near the ground level exit. The designer needs to consider the ramifications of a fire occurring at the landing of the nominated floor so ideally an alarm at that landing, or an instruction from the fire control centre, would redirect lifts to another landing. Again, this could complicate and compromise the lift controls. The alternative is minimise the risk of a fire at a transfer landing (or the landing of the nominated floor) by treating the landing as a NCC 'exit' and applying the appropriate provisions, such as having no combustible materials in the area and having the area fire isolated with appropriate smoke management. This would mean that the nominated floor landing, and the path out of the building, would be as safe as any exit path.

Where occupants need to change to another lift (possibly an express lift) at particular levels—or if they exit the lift at a nominated floor other than the entrance level—the role of the Warden at that landing would be important as they would need to advise and direct the building occupants on how to proceed.

7.2.2 Landing fire protection

If the landing is open or contains combustible material it is potentially a place where a fire could occur. The lift is less likely to be a sustainable path of egress. In that case, management practices would need to revert to those for requiring assisted evacuation or using refuges. For people to wait at a landing it needs to be protected from fire and smoke for a significant time.

The level of fire isolation and protection at a landing needs to be comparable to that of a fire-isolated exit stairway. However, if the building has a sprinkler system, smoke will be the greatest danger.

For lift landings to be used for people to wait during an evacuation, their construction should be fully enclosed and protected either with-

- smoke-proof elements and pressurisation if the building has a sprinkler system; or
- fire-resistant and smoke-proof elements and pressurisation if the building does not have a sprinkler system.

These measures effectively result in the landing forming a lobby or a refuge (i.e. a safe staging area or assembly area).

The landing or refuge should also be associated with a stairway so that occupants could move into the stairway if the integrity of the lift, landing or refuge is compromised.

Where a lift lobby or refuge is sprinkler protected, there would be a benefit in the sprinkler system serving those areas to be separated from the remainder of the building, or, possibly having separate alarms, this would ensure when a fire elsewhere on the floor causes an alarm, it does not impact on the lifts operation until the alarm at the lift landing or refuge is raised.

AFAC and FPA both strongly recommend the sprinkler protecting of buildings where lifts are to be used for evacuation including smoke isolation of lift landings.

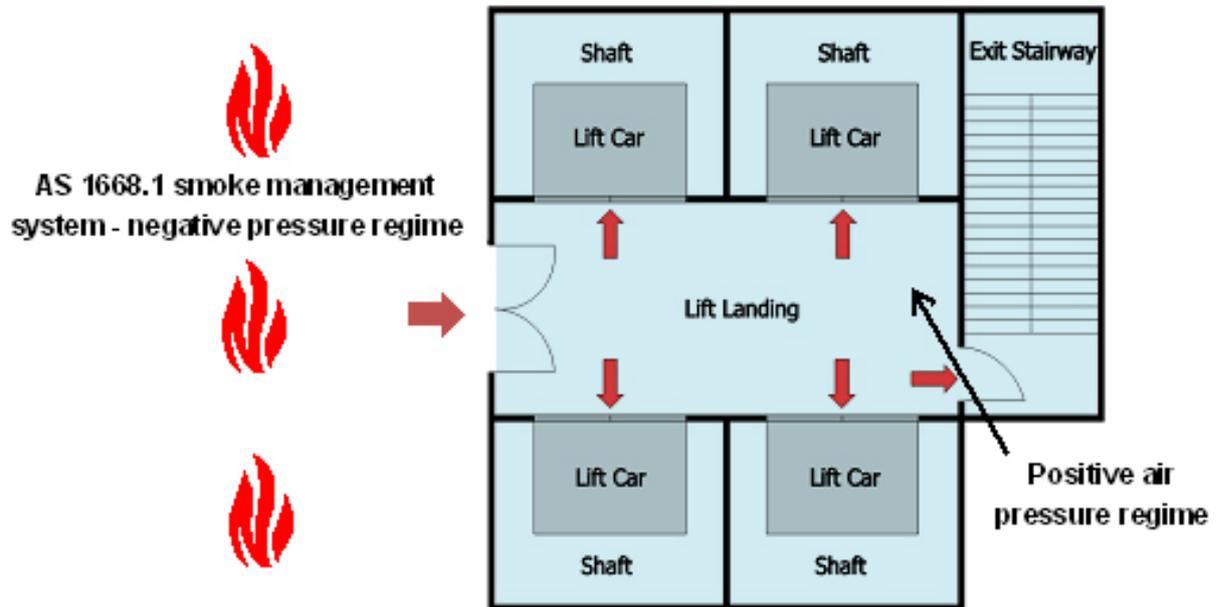
Whatever the means are to provide fire and smoke separation from the fire affected area, it is crucial that performance criteria be set so that occupants waiting on the lift landing will be protected from untenable conditions for a period of time long enough to evacuate.

There is no requirement for leak tightness, or to avoid distortion that may increase leakage possibly causing the lift doors not to operate by jamming. If a fire has sufficiently advanced to distort a lift door, then under any of the control options proposed, an alarm at that landing should have sent the lifts to the nominated floor to be unloaded and taken out of service before the fire has even reached the lift doors.

If a lift shaft is required to be fire-isolated by the NCC, the DtS Provisions require lift landing doors to be protected with a fire-resistance level for integrity (the ability to resist the passage of flames) of 60 minutes when determined in accordance with AS 1735.11. "Lifts, escalators and moving walks - Part 11: Fire-rated landing doors".

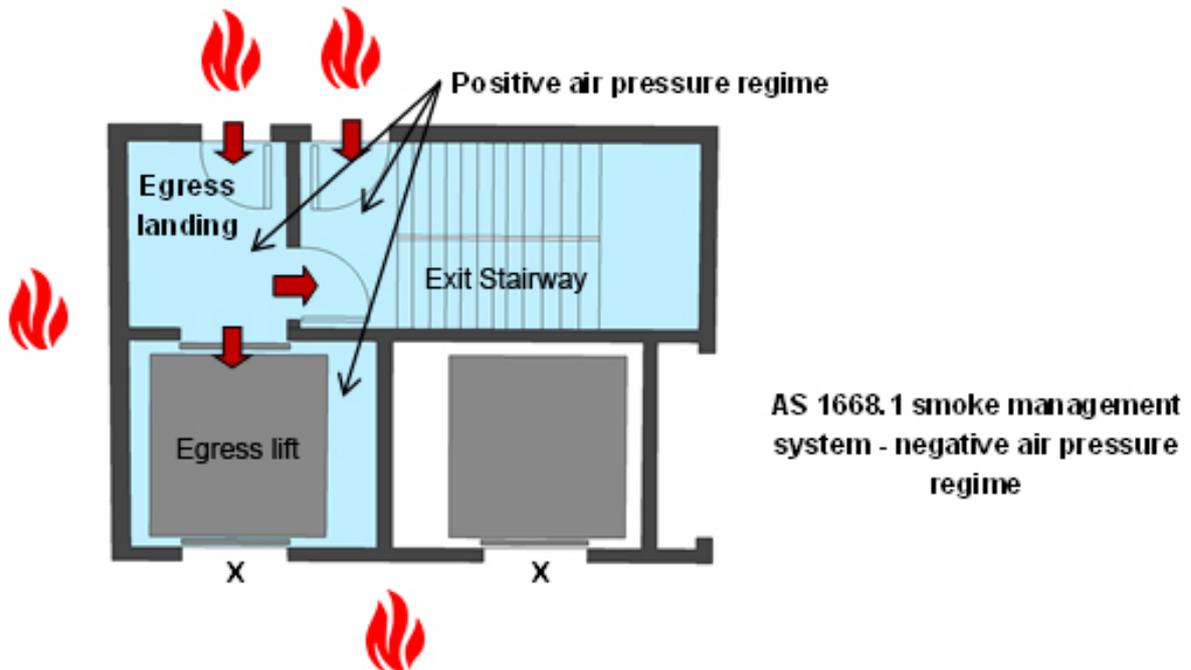
Figure 7.2 shows a typical enclosed landing that provides a lobby that can be protected.

Figure 7.2 Protected lift landing - general use lobby



Some buildings have an open landing configuration where the lifts open directly onto the occupied space. In this situation a protected landing would need to be created for at least the people who cannot use the fire-isolated stairways in an emergency. This protected landing would effectively form a refuge, but in doing so, have all of the features discussed. Figure 7.3 shows a possible configuration, although having a different egress path to the access path would need to be made known and included in the occupant's PEEP. Visitors would need to be directed by hosts, Wardens and suitable signage.

Figure 7.3 Protected lift landing - dedicated signage



Lift landing pressurisation would need to complement and not compromise the stairway pressurisation system.

7.3 Landing signage

The availability of lifts in an emergency would need to be clearly communicated to the building occupants and this includes people with a hearing or sight disability. The DtS Provisions currently require warning signs that read “Do not use lifts if there is a fire”; however, the Performance Requirement EP3.3 only requires that signs or other means be provided to alert occupants about the use of a lift during an emergency. It is neutral as to whether lifts should, or should not, be used for evacuation.

Because the DtS Provisions are well entrenched, an effort would need to be made to communicate that lifts may be used. It would also need to be clear as to whether they are for everybody or just people needing assistance. The wording could be similar to “These lifts are available for evacuation” or “These lifts are available for people unable to use stairways to evacuate”, depending upon the strategy.

As the availability of lifts for evacuation is likely to be the exception rather than the rule, the signage being in braille, tactile or pictogram could be considered but would depend upon its practicality for the type and size of building. A wheelchair entering a lift and a

fire symbol would be a suitable pictogram. In any case, how people with vision impairment would be made aware needs to be considered.

Any additional signage would need to be consistently located throughout the building.

The evacuation diagrams described in AS 3745 would also need to be considered.

It may not be necessary to provide additional direction signage on the storey if the path to the evacuation lift retraces paths of travel. However, if the path for evacuation is different, such as in Figure 7.3, additional signage may be needed for visitors as it is not the path by which they entered the building. Regular occupants needing to use the lift would be aware of their availability through their PEEP.

In any case, audio directions should be provided for people with vision impairment.

The alternative signage, audible advice, training and Warden assistance needs to be specific to the building and part of the emergency plan.

7.4 Lift shafts and lift machinery spaces

7.4.1 Fire protection

In most buildings, the NCC requires that lift shafts and lift machinery rooms be enclosed with non-combustible, fire-resisting walls, roofs, floors and doors. This should be the minimum requirement for all lifts and lifting devices used for evacuation.

To avoid water damage in those buildings where sprinklers are required by the NCC, the DtS Provisions currently require a dry pipe type installation where lift electrical and control equipment is located in a space protected with a sprinkler system, including machine rooms, secondary floors and sheave rooms.

7.4.2 Operating temperature

The temperature in the lift shaft required by the NCC DtS Provisions is a maximum of 40°C. In the event of a fire, the smoke management system for the fire-affected areas will vent hot smoke and so the ambient temperature around a roof-top may exceed the otherwise day time maximum temperature (depending upon the exhaust and intake locations). Efforts need to be made to keep any machinery in the lift shaft or lift machinery areas cool or use equipment that is able to withstand higher temperatures.

If the temperature in the lift and shaft exceeds the safe working temperature, the lifts should immediately be directed to the nominated floor (or another floor that is safe) and

then be taken out of service. To avoid this, the ventilation or cooling system should also be connected to the reliable back-up power supply.

7.4.3 Lift shaft air supply

As well as requiring that the lift shaft temperature not exceed 40°C, the lift shaft would need to be ventilated to dilute smoke, and provide controlled pressurisation similar to the landings to avoid doors jamming and provide outdoor air for the lift car occupants.

The proximity of the outside air source to any smoke discharge would need to be considered and smoke detection in the shaft would be needed for the alarm system to then take the lift out of service.

7.5 Lift cars

Irrespective of whether the evacuation strategy is to protect-in-place, phased partial evacuation, phased full evacuation or simultaneous full evacuation, an evacuation lift car needs to have the same high standard of safety features. The lift car should also provide comparable safety to that provided by other NCC means of egress to the degree practical and as a minimum the lift car should have features comparable to (or better than) an emergency lift. For a lift to supplement egress it will need to be appropriately sized for the anticipated usage, including manoeuvring space for wheelchairs and all the controls required of a passenger lift for people with a disability.

Once people are in a lift car their safety will depend on the lift machinery, the power supply, the fire-isolation of the shaft, the door construction, the outside-air system and the lighting all being reliable and protected from the effects of fire.

For lighting, the NCC DtS Provisions require the artificial lighting of exit stairways, passageways, and ramps to comply with AS/NZS 1680.0 but the NCC has DtS Provisions (as does the Premises Standard) for lighting in a lift car to comply with AS 1735.12 for people with a disability.

Surveillance in the lift car from the fire control centre is also desirable as well as two-way communication. Again, a text display messaging would benefit people with a hearing disability.

7.6 Lift operation

The lift control system interfaces with the building fire alarm system so that a fire alarm initiates a specific lift control sequence.

There are differing views on the most appropriate steps in the control sequence ranging from the current approach of immediately commencing a fire service recall or shutdown to a much more intelligent but complex dynamic logic approach.

Some international publications advocate intervention by the fire control centre or the building management system if it is determined that there is an unacceptable level of risk to people using lifts for egress. This remote intervention could also advise passengers to leave the lift or not to enter the lift, close the lift doors and direct the lifts away from the hazard. Such an approach would require a high level of communication between the fire alarm system, the communication systems and the lift control system. The lift industry advise that such communication means are still in the developmental stage with the requirements still being determined through the ISO standard process. Until such time as the international lift industry completes development, a conservative approach should be taken.

As the height and complexity of buildings increase, the desire to increase the sophistication of the lift control system is also increasing. However, lifts are imported with software that has been pre-programmed, tested and verified to stringent regimes, and to attempt to vary the programming may result in unintended faults or compromise intrinsic safety features. Ideally, any evacuation strategy should not include interfering with the manufacturer's programming.

The following are two operational approaches. The first, approach A, is based on a lift control system that only responds to a fire or smoke alarm in a lift, lift shaft, lift motor area or on a lift landing and it does so with a single response (i.e. commence its fire service recall sequence immediately). This is how lifts are currently controlled and relies on the building fire and smoke compartmentation to permit timely evacuation. The second, approach B, is based on a lift control system that automatically responds to the evacuation needs of individual floors with the priority being determined by the fire control system. There may be other approaches that are variations of these two but for simplicity only these two will be discussed.

With both approaches the emergency services personnel can take-over operation of any lift at any time and after the emergency has passed, quickly return lifts to service when it is determined to be safe to do so. Particularly if there has been a partial evacuation.

7.6.1 Lift operational approaches

The current fire service recall sequence

The current DtS Provisions in E3.7 in Volume One of NCC require that if an alarm is received by the fire panel, or is initiated by the recall switch on the nominated floor, all lifts in the building, or part of the building, will cease responding to calls, immediately return to the nominated floor and remain there with the doors open, discharging passengers and ready for the emergency services personnel.

At any time the lifts may be manually taken out of service or returned to controlled service after a fire service recall alarm by the emergency services personnel (or the Warden if appropriately trained and if considered safe to do so). They can then evacuate people from the fire-affected storeys.

This is the situation now and would also remain in the two operational approaches discussed below.

Operational approach A: Fire service recall on an alarm from a lift, a lift landing or a lift shaft

This approach relies on the fire alarm system distinguishing between a fire on a lift landing, in a lift machine area or in a lift shaft from elsewhere in the building.

On an alarm from anywhere in the building other than a lift landing, lift machine area or a lift shaft, the fire alarm system would send signals to the various required locations but not to the lift control system and so the lifts would continue to operate normally and respond to calls.

Therefore, the lifts may continue in operation. This approach relies on Wardens being on the landings that are not under immediate threat (including the entrance levels) to control lift calls. This will avoid people from calling the lifts and directing them away from where they are most needed. If a lift respond to all calls it may become fully loaded and so bypass the landings where it is most needed. A suitably trained Warden could also take control of the lifts and run them as a shuttle service from the fire floor.

On an alarm from a lift lobby, lift machine area, or a lift shaft, the alarm system would need to send a signal to the lift control system to initiate the fire service recall sequence described above for all lifts serving that lobby or contained in that shaft. For an express lift to continue to operate, it would need to be in a separate shaft.

With this approach, all lifts should be fitted as emergency lifts because all lifts may be in operation when the emergency services personnel arrive and they will need to take control of the next lift to arrive at the nominated floor. It would also be advantageous if all lifts were emergency lifts for when a lift is out-of-service for maintenance.

The traditional lift control system software is suitable for this approach without modification.

AFAC and SFS advise that this is not their preferred option as it makes the evacuation strategy reliant on the judgment of Floor or Area Wardens who may not be available.

Operational approach B - Priority control

If there is an alarm from anywhere in the building (again, other than from a lift landing, lift machine area or lift shaft) the alarm system would send a signal to the lift control system for one lift (a NCC emergency lift) to go into its fire service recall sequence and proceed to the nominated floor. There it would wait for the emergency services personnel.

The remaining lifts would respond to calls from the fire landing as first priority, one landing above as second priority, two landings above as third priority and one landing below as fourth priority. The number of starts and stops of a lift during the evacuation should be minimised (i.e. the lifts run in an “express” mode). Also, lifts being used for evacuation should not respond to calls from other landings.

When another signal is received from the fire alarm system that there is an alarm from a lift landing, lift machine area or a lift shaft, the lift control system would then initiate the standard fire service recall sequence described above for all lifts associated with that lift landing, lift machine area or lift shaft.

International opinion seems to be mixed as to whether lifts may continue to operate normally in an emergency—provided they bypass a landing from where an alarm has been received or are express lifts in the same shaft but do not serve that landing. The opposing view is that lifts should cease normal operation upon an alarm. The difference may be reconciled by considering the degree of fire and water isolation of the lifts and the lift shaft, and the robustness or independence of the lift control systems.

This approach is favoured by some fire authorities as it lends itself to the strategy of anybody using the lifts for evacuation as well as automatically granting priority to the people on the fire affected floor. This would involve multiple and dynamic signalling between the fire panels and the lift control system.

It is understood that while the interface between the fire indicator panel and the lift controller is not a difficult prospect for most addressable programmable panels (requiring the mapping of relay outputs after developing a cause and effect matrix) it could make the fire panel interface more complicated. As the fire may move through the building the priorities will also change. Currently the software is based on optimising travel patterns and waiting times rather than responding to fire alarms.

Because of the more complex control functions with this approach, the decision chart ISO/TR 25743: 2010(E) and the need for reliability and availability studies becomes increasingly important as well as a need for greater testing and retesting along with strict management and security of any changes to the control functions. While such sophistication may not be either available or cost effective at the time of writing this Handbook, advances in innovation and market forces may make it viable in the near future.

The Australian Elevator Association advises that changing the lift management software would not only be very costly but would require new communication protocols and extensive retesting to avoid the software's integrity from being compromised. It should only be considered when available as part of the lift manufacturer's standard software or the when the software permits the modifications to be carried out with confidence.

While this approach is the operational goal of some fire authorities, the Australian lift industry advises that as the communication protocols have not been developed for lifts internationally, achieving this level of control sophistication would require the lift management software to be significantly changed. International organisations are currently working on these communication protocols but realistically it is expected to take 2 to 3 years for them to be completed and commercially available. When this occurs this Handbook will need revising.

7.6.2 Fire and smoke alarm zoning

For the above approaches there is a need to consider the zoning of alarms on lift landings, in lift machinery areas and in lift shafts separately from other parts of the building.

In operational approach 'A' the lift landing, lift machine area and lift shaft alarms could be combined into a lift zone. An alarm from this zone would result in all evacuation lifts serving those areas being recalled to the nominated floor.

Operational approach 'B' would be more complex requiring each landing to effectively be a separate alarm zone. The zoning would also be more complicated if evacuation

lifts were to continue to operate and bypass a compromised landing until such time as the lift shaft was unsafe.

The sensors selected for these lift zones should be ones with the greatest sensitivity and reliability that can ensure a faster response time.

7.6.3 Security systems

As with emergency lifts, any security devices on evacuation lifts and landing access doors would need to be disabled in an emergency.

7.7 Smoke management & air pressurisation

Smoke is all pervasive and can easily spread. Smoke barriers alone cannot stop smoke migration. Wind pressures can drive smoke from one side of a building to another and smoke can quickly circulate through air-conditioning systems. If people are to be encouraged to remain in a building under a phased evacuation strategy or wait for a lift, anxiety effective smoke management is essential.

The NCC DtS Provisions require smoke management in buildings over 25 m high, and in some less than 25 m. The DtS Provisions where smoke management is required are for compliance with AS/NZS 1668.1 “The use of ventilation and air-conditioning in buildings - Fire and smoke control in multi-compartment buildings”. The NCC requires exit stairways and any other escape exits to be kept at an air pressure positive to the fire compartment. If lifts are to be used to assist evacuation, the lift shaft and lift landings would also need to be kept at a pressure positive to the fire compartment.

Smoke detection is needed in lift cars, at the tops of lift shafts, in lift machinery spaces and at each lift landing. Activation of any of these smoke detectors should, in an automatic mode, cause the lift to be removed from service. The lift should then inform the fire control centre and any building management system that it is no longer available. It is noted that ISO/TR 25743 advises that it may be safe for a lift to pass a storey where there is a hazard, even if some smoke enters the lift shaft and is detected, however this approach is not supported by AFAC.

If, to manage smoke, the lift shaft is pressurised in a fire, the following issues need to be considered by the designers:

- The air pressures in the lift shaft and on a landing need to be sufficiently close in value so that the differential pressure will not cause the doors to jam.
- In the lift shaft of a high-rise building there is a strong stack effect which results in progressively lower absolute pressures down in the lift shaft. This means that to

maintain the lift shaft at a pressure positive to the fire compartment, the lift shaft would need to be pressurised, and pressurised to a constant pressure throughout.

- The piston effect of the lift also may make maintaining pressure regimes and smoke control more difficult than in a conventional AS/NZS 1668.1 compliant system. The HVAC engineer will need to demonstrate that the piston effect will not compromise pressures on landings or induce smoke into the lift shaft.

With a number of factors affecting smoke migration, the designers should produce a cause and effect matrix for smoke management and integrate it with the cause and effect matrix for all other systems. This means that the air-conditioning engineer, lift engineer, and fire engineer need to work together to design a smoke management system that will maintain the correct pressures.

Figure 7.4 and Figure 7.5 illustrate how an AS1668.1 smoke management system could be extended to protect lift landings.

Figure 7.4 Smoke management system – Air-conditioning and ventilation system in normal operating mode

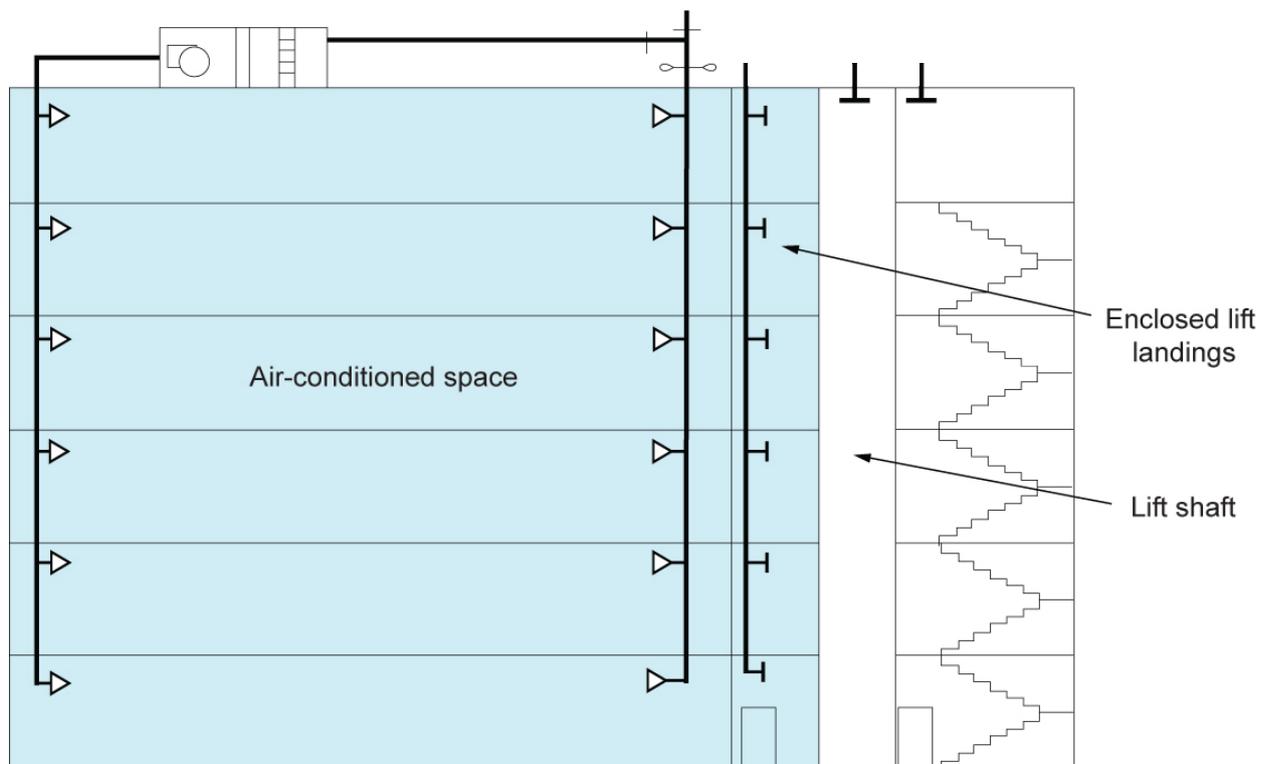
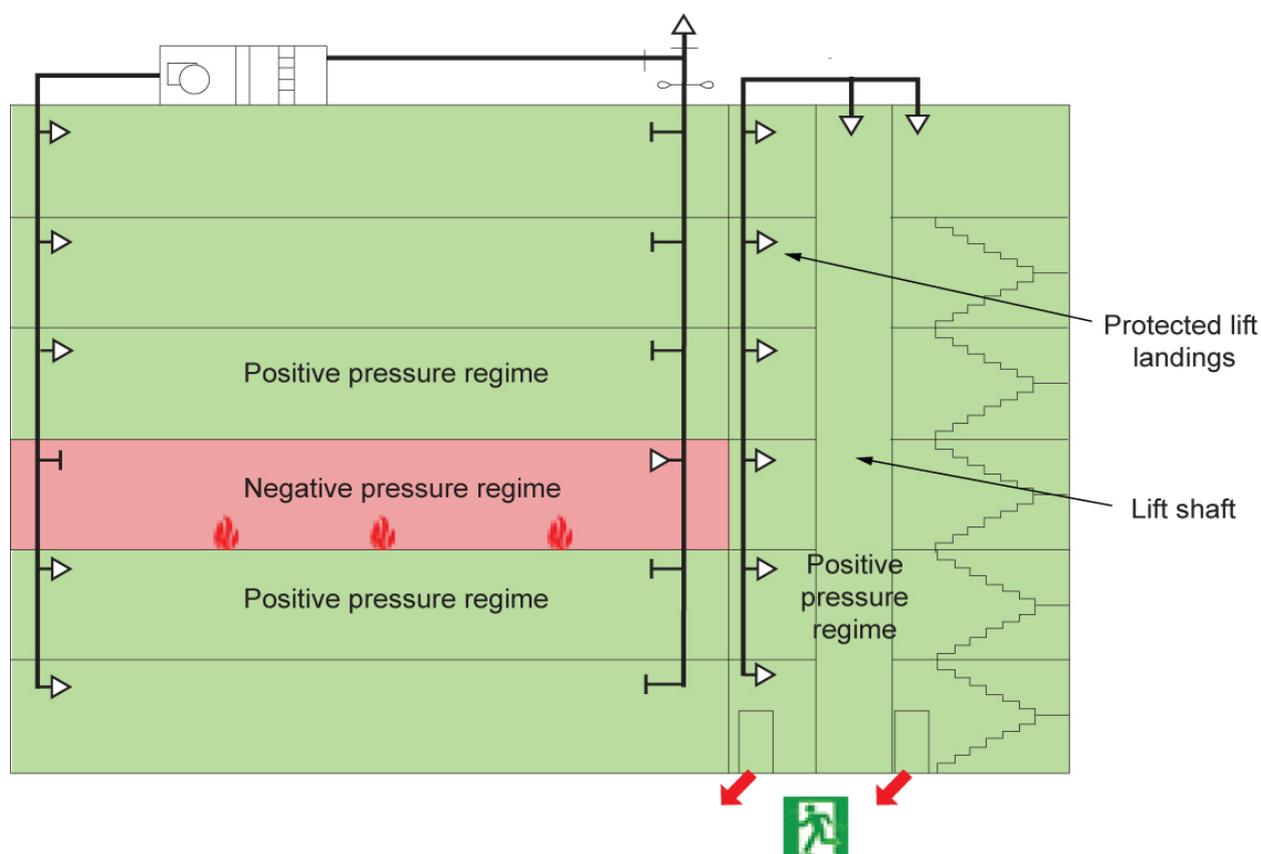


Figure 7.5 Smoke management systems – Air-conditioning and ventilation systems in smoke management mode



7.8 Power supply

A building with a single lift is likely to be a small building and if it were out of service because of a lack of power, assisting people down the exit stairways may be reasonable. However, a building with a bank of lifts that is relying on the lifts being available to supplement evacuation of anybody would be seriously disadvantaged if all lifts were out of service because of a power failure. The power supply reliability will also need to include a lift if it is to be used for evacuation.

A reliable supply can be either by multiple power feeds from the grid or back-up generators. In addition various other evacuation lift related systems would need a reliable power supply including power and control circuits, life support and lift operation ventilation, equipment cooling as well as communication circuits. Also, if emergency generators were used to provide emergency power, the capacity of stored fuel to supply power for the evacuation time or the reliability of a reticulated fuel supply, needs to be assessed. Gas, for example, should not be automatically turned off upon a general fire alarm.

The alternate power supply (be it multiple feeds or back-up generators) would need to commence and change-over automatically. The lift system should automatically recommence, after pausing during the change-over, without needing any manual intervention. An uninterrupted power supply would be preferred but unlikely to be cost effective.

The quality of the power during start-up, the sequencing of lifts coming back into service and the capacity of the back-up power supply need to be determined. Poor quality power may result in the lift motor protection stopping them from being reinstated.

The NCC requires that an emergency lift in a Class 9a building serving a patient care area be connected to a standby power supply system where one is installed.

7.9 Avoiding water damage

Water or other fluids can come from sprinklers, hoses, damaged services pipes, ruptured roof-top water tanks or flooding but in a fire it is most likely to come from the fire suppression systems. The lift's electrics (drives, lighting, life support, alarms and communications) need to be protected so as to continue in operation during the emergency. However, to waterproof all the components would not be cost effective and so every effort needs to be made to keep water away from lift components.

Although it is not anticipated that fire hoses will be deliberately directed at a lift or its equipment, a high-rise building (over 25 metres) will have a sprinkler system and even a low rise-building may have a sprinkler system under a Performance Solution.

If a fire reaches a landing it should be assumed that the lift's operation has been compromised and all lifts in that shaft go into their fire service recall sequence.

The following precautions would also need to be taken to reduce the likelihood of water entering the lift machinery:

- Construct shaft enclosures and any penetrations in such a way that water from adjacent areas cannot spill over into the lift shaft (for example by installing a curb in non-traffic areas or by grading the floor in traffic areas).
- Provide lift shaft drainage or sumps sufficient to maintain the water level below the fully compressed car buffer.

If the lower level of the lift shaft is flooded, this needs to be detected and transmitted to the fire control centre for a decision as to whether to remove an evacuation lift from service or whether to permit it to continue.

7.10 Monitoring the hazard and the occupants

Where fire control centre personnel have the ability to make decisions and adjust the egress strategy during the evacuation, real-time information on the hazards and the movement of occupants is essential.

The most straight-forward management practice during normal occupancy periods is to have Floor or Area Wardens allocated to each location who can then communicate with the fire control centre. Although, this is not ideal in some buildings such as private residential buildings.

Closed circuit television (CCTV) can supplement monitoring and would provide a more comprehensive picture of the situation. Also, CCTV coverage could include lifts, landings, stairways, exits and if possible, open floor areas or paths of travel to the landings and exits. In this way occupants could be kept informed through the sound system and intercom system. For example, they could be directed to move to an alternative exit stairway to avoid some congestion, especially where crossover corridors or refuge storeys are provided.

If CCTV is to be part of a Performance Solution, it would need to be on an essential power circuit, with protected cabling and back-up power supply.

7.11 Communications and signage

As people are likely to be familiar with the evacuation procedures based on the DtS Provisions in the NCC, and as buildings in which lifts may be used for evacuation are designed as Performance Solutions (possibly with different strategies) people entering such a building would need to be made aware of any unique evacuation procedures. This would involve appropriate signage at the lifts that is sufficiently prominent as to attract the occupant's attention. Where a goods lift is to be used for evacuation many additional aspects would need to be considered, including signage advising users (who are often contractors) that the lift is to be immediately emptied on an alarm and passageways kept clear.

A sound system and intercom system in accordance with AS 1670.4 should be installed where evacuation lifts are to supplement egress. This is a mandatory DtS Provision of the NCC for buildings over 25 m and for some with a footprint greater than 18,000m² but should be part of a Performance Solution for any building if lifts are to be used during evacuation.

Two-way communication would be needed:

- At the master emergency control panel, fire indicator panels and lift annunciation panels as well as the fire control centre where one exists.
- In the staging or assembly areas (protected landings, protected lobbies or any refuges).
- In each lift.

There has been a trend in recent years not to provide two-way communication in some non-emergency lifts but if the lifts are to be used during evacuation this form of communication is highly desirable.

Modern lift control systems interpret the number of times a call button is pressed as meaning that more people are waiting. In an emergency, people on landings are likely to repeatedly press the call button so the button should indicate that a call has been made and whether the lift is in service.

People waiting need to be informed of the lift's movements. Likewise, if an evacuation lift is being removed from service, people waiting on landings need to be informed of the situation. This information should be given visually and audibly on the landing adjacent to the relevant lift. The audible information should be repeated at short intervals until the announcement is no longer needed.

Although not commercially available at the time of publication of this Handbook, a texting keyboard may be more useful than a telephone for a person with a hearing disability.

7.12 Commissioning, maintenance and on-going testing

For an evacuation lift, testing and maintenance would need to be more rigorous and more extensive than for a routine access lift and should include all the ancillary systems. An evacuation lift would be a piece of essential equipment as much as a fire pump or a smoke exhaust fan and needs to undergo a rigorous commissioning regime plus appropriate maintenance and on-going testing routine. The testing and maintenance would also need to be more frequent. The maintenance would need to be unique to each lift and its ancillary equipment.

Commissioning and ongoing testing would include every item that was considered in one of the above studies and how it behaves as part of a system. In particular, attention should be paid to the life support, power supply, communications, warning and smoke management systems.

Commissioning and ongoing testing is most important for the complex interfacing and interconnecting of systems. The operation of interfaced and interconnected systems needs to be comprehensively documented in the form of manuals and needs to be well understood by the operating and maintenance staff or contractors, and the emergency control organisation.

To understand the strategy intended, there may be a need for the involvement of members of the design team, including the NCC specialist and the emergency services personnel, at the initial commissioning and also during key on-going re-testing activities.

With more sophisticated control systems also comes a need for strict management and security of any changes to the control functions.

The level of supervision and regulatory oversight of the commissioning, the ongoing management of maintenance, system changes and the periodic retesting are all matters for the particular jurisdiction to determine, possibly on a building-by-building basis.

The emergency plan and associated elements need to be inspected and tested at periodic intervals and verified against specific criteria. Simulation system testing and emergency response exercises are a component. AS 1851 provides guidance on these activities.

7.13 Summary of essential elements for an evacuation lift

To use lifts for evacuation, essential lift and lift services elements include the following:

- Egress paths, landing space and lift size suitable for the number of people likely to use the lift in an emergency including adequate wheelchair manoeuvring space.
- A lift landing area protected from fire and smoke be it a lobby or refuge.
- High sensitivity smoke and fire detectors on lift landings, in the lift shaft and the lift machinery areas, zoned separately from all other areas so as to be the only alarms to initiate the lift shut-down sequence.
- If the building has a sprinkler system, provision for water from other areas to be drained away from lift doors and sprinkler heads with a high temperature rating heads in machine rooms and machine areas.
- The management of smoke to protect landing areas and lift shafts.
- Audio and visual warning alarms suitable for people with a disability.
- Two-way communication between landings, lift cars and the fire indicator panel or the fire control centre, again, suitable for people with disabilities to use at the landing and in the lift car.

- Appropriate signage on whether lifts can be used in an emergency and who may use them noting that different Alternative Solutions may warrant different signage thereby possibly leading to confusion for transient people, and again, being suitable for people with a disability.
- A reliable, redundant power supply.
- Complementary emergency management procedures including a building specific emergency plan, commissioning, inspection, testing and maintenance.

Whether lifts are used for evacuation by only people needing assistance or whether they are used by any building occupant should not affect the reliability and life safety elements. The aspects that would impact the decision on who could use the lifts would be the size of the building, the emergency plan, the size of the protected landings, the number of people on that level and the number of lifts available.

Appendix A Australian and International Practices

A.1 Australia

A.1.1 Safe Work Australia

Safe Work Australia, in conjunction with the State and Territory governments, has produced 'Model Work Health and Safety Regulations' (March 2016) which includes provisions for emergency plans.

A.1.2 Standards Australia

Standards Australia have a number of standards relevant for protecting occupants evacuating a building in an emergency some of which are referenced by the NCC Volume One. However, three relevant standards that are not referenced by the NCC are-

1. AS 3745-2010, 'Planning for emergencies in facilities'
2. AS 4083-2010, 'Planning for emergencies—Health care facilities'
3. AS 1851-2012, 'Routine testing of fire protection systems and equipment'

The objective of these Standards is to enhance the safety of building occupants by providing a framework for emergency planning. The first two standards outline minimum requirements for the establishment, validation and implementation of emergency plans to provide for the safety of occupants of buildings, including visitors, leading up to, and during an evacuation. They include the following:

- The formation, purpose, responsibility and training of an emergency planning committee.
- Emergency identification means.
- The development of an emergency plan.
- The development, testing and validation of emergency response procedures.
- The establishment, authority and training of an emergency control organisation.
- Emergency related training.

A.1.3 Metropolitan Fire and Emergency Services Board (MFB); Melbourne

The Metropolitan Fire and Emergency Services Board have produced three guideline documents relevant to egress from high-rise buildings. They are:

1. Guideline GL-07: “Single Fire Isolated Stair in High-Rise Building”
2. Guideline GL-18: “Evacuation of High-Rise Buildings”
3. Guideline GL-31: “Use of Lifts for Evacuation”

These Guidelines provide advice on what should be considered when proposing a Performance Solution. When using lifts for evacuation, their recommendations include the following:

- That the building be fully sprinkled.
- That there are trained Wardens.
- That there is an emergency management structure.
- That the lift system be capable of a range of functions including safe sequencing of lift movement.
- That there is no reduction in the number and dimensions of exits.
- That there be a sufficient number of lifts for simultaneous occupant evacuation and emergency services personnel entry.
- That there be “safe haven” protected lobbies.
- That the lifts be safe, reliable and the lift machinery be protected.

A.2 Canada

The National Building Code of Canada (NBC) 2010, together with the National Plumbing Code of Canada 2010 (NPC) and the National Fire Code of Canada 2010 (NFC), form an objective-based National Model Code. Adoption is the choice of the provincial and territorial governments.

In Canada, provincial and territorial governments have the authority to enact legislation that regulates building design and construction within their jurisdictions. This legislation may include the adoption of the NBC without change or with modifications to suit local needs, and the enactment of other laws and regulations regarding building design and construction, including the requirements for professional involvement.

A.2.1 National Building Code of Canada 2010

The NBC sets out technical provisions for the design and construction of new buildings. It also applies to the alteration, change of use and demolition of existing buildings.

The NBC establishes requirements to address the following four objectives, which are fully described in Division A of the Code:

- Safety.
- Health.
- Accessibility for persons with disabilities.
- Fire and structural protection of buildings.

Code provisions do not necessarily address all the characteristics of buildings that might be considered to have a bearing on the Code's objectives. Through the extensive consensus process used to develop and maintain the National Model Codes, the code-user community has decided which characteristics should be regulated through the NBC.

Because the NBC is a model code, its requirements can be considered as the minimum acceptable measures required to adequately achieve the above-listed objectives, as recommended by the Canadian Commission on Building and Fire Codes. They become minimum acceptable requirements once they are adopted and passed into law or regulation by the authority having jurisdiction (i.e. the requirements represent the minimum level of performance required to achieve the objectives that is acceptable to the adopting authority).

The NBC and NFC each contain provisions that deal with the safety of persons in buildings in the event of a fire and the protection of buildings from the effects of fire. These two National Model Codes are developed as complementary and coordinated documents to minimise the possibility of their containing conflicting provisions. It is expected that buildings comply with both the NBC and the NFC. The NBC generally applies at the time of construction and reconstruction while the NFC applies to the operation and maintenance of the fire-related features of buildings in use.

A.2.2 National Fire Code of Canada 2010

The National Fire Code includes provisions for the following:

- The on-going maintenance and use of the fire safety and fire protection features incorporated in buildings.

- The conduct of activities that might cause fire hazards in and around buildings.
- Limitations on hazardous contents in and around buildings.
- The establishment of fire safety plans.
- Fire safety at construction and demolition sites.

The risks of injury due to fire addressed in this Code are those caused by one of more of the following:

- Fire or explosion occurring.
- Fire or explosion impacting areas beyond its point of origin.
- Collapse of physical elements due to a fire or explosion.
- Fire safety systems failing to function as expected.
- Persons being delayed in or impeded from moving to a safe place during a fire emergency.

The code contains a requirement that emergency procedures used in the event of fire include special provisions for evacuating occupants that require assistance.

A.3 Hong Kong

The Hong Kong Code of Practice for Fire Safety in Buildings (Sept 2011) is a performance-based code. The prescriptive part requires a refuge floor on every 20 storeys or 25 storeys depending on the building use classification, for buildings exceeding 25 storeys in height. However, the refuge floor requirement does not apply to domestic buildings or composite buildings not exceeding 40 storeys in height (above the lowest ground storey). The code also requires that such buildings be served by a fireman's lift to facilitate rescue assistance. These requirements have also been adopted in other areas of China and in some other Asian countries.

A.4 International Organization for Standardization (ISO)

ISO/TR25743: 2010(E) 'Lifts (elevators) – Study of the use of lifts for evacuation during an emergency'. This technical report provides information on risks to persons using lifts to evacuate a building during an emergency. The document proposes an evaluation of risk using a "decision tree" and provides information related to specific questions.

It summarises that the greatest number of issues to resolve relate to the design of the building rather than the lifts and suggests that it should be possible in certain buildings to reduce evacuation time by permitting people with a disability to safely use lifts for evacuation.

ISO / IEC Guide 71 2002 – ‘Guidelines for standards developers to address the needs of older persons and persons with disabilities’. The purpose of this document is to provide organisations involved in writing standards with information that can assist the effectiveness of their documents when applied to older persons or persons with disabilities. While not containing specific information related to building egress systems, it provides valuable information on issues such as; luminescence, visibility, colour, hearing sensitivity, audible signals, graphics and signage, which can be used in the design of components of egress systems.

ISO is also preparing a document on requirements for lifts used to assist in building evacuation. The document is primarily about the lifts rather than emergency evacuation and is still in development and so may not be available for another two years.

A.5 Japan

The Building Standard Law of Japan 2004 (BSL) is a performance-based code that provides minimum standards concerning the site, construction, equipment, and use of buildings. Access to buildings and other public facilities is addressed through separate legislation.

The BSL does not specifically address egress for people with a disability. Provisions for egress of people with a disability are presented in emergency evacuation management plans for individual buildings and these plans are submitted to fire service authorities for approval.

A.6 Norway

The Norwegian building code appears to be similar to the NCC in that it is performance-based and the performance requirements for egress apply to all building occupants. However; the acceptable solutions outlined in the accompanying guidance to the code are mainly designed for people without a disability.

A.7 United Kingdom

The United Kingdom has a performance-based code that applies in England and Wales and Approved Documents which contain approved building solutions. Approved Document B Volume 2 (2006) deals with Fire Safety in buildings other than dwelling houses. Performance requirement B1 is generic (i.e. it does not differentiate between ambulant people and people with a disability). Only a guidance note to the requirement identifies potential issues relating to emergency egress for people with a disability.

Approved Document B requires that buildings in excess of 30m high be designed for phased evacuation and that stair capacity be based on one exit stairway being discounted due to use by emergency personnel. Arrangements are to be determined in consultation with the fire service. An additional requirement is that these buildings be equipped with a fire-fighting shaft including a protected lift dedicated to emergency response service.

Approved Document M addresses access and use of facilities in buildings by people with a disability; however it does not specifically address egress by people with a disability.

UK legislation requires employers to implement effective arrangements for access and emergency evacuation for employees and visitors. Part of the requirement is the completion of a PEEP for people with a disability. The PEEP addresses the safety of a specific individual and records the safety plan, including evacuation routes, corridors, stairs or refuges. It also identifies people who will assist the individual and their training or practice needs. It proposes the use of emergency lifts and safe refuges that are protected from fire.

In public places UK workplace legislation proposes that employers, when conducting a fire risk assessment and considering the means of escape from a fire, incorporate the recommendations of the British Standards Institute BS 9999: 2008 – ‘Fire safety code of practice for the design, management, and use of buildings’. This document specifies what is required in relation to building design, lift design and building management responsibilities and procedures including providing information on improving accessibility for people with a disability in fire safety design and management plans. The BS 9999 series reflects the requirements of the Disability Discrimination Act and the principles of inclusive design. The content of the standard includes the following:

- Risk profiles and assessing risk.
- Managing fire safety.
- Access and facilities for fire-fighting.
- Maintenance of building plant and equipment.
- Provision for people at particular risk including the evacuation of people with a disability including.
- Fire control centre functions.
- Evacuation management.
- Use of Personal Emergency Evacuation Plans (PEEPs).
- Use of refuges, including their size, their construction and their location.

- Evacuation using lifts, including the construction of their protected enclosure and lobby, their independent power circuit, their supervision and their control functions.

A.8 United States of America

A.8.1 International Building Code 2012

The International Building Code (IBC) 2012, produced by the International Code Council (ICC), is a model building code understood to be widely used in the USA. The Code has undergone significant changes in recent years particularly for the use of lifts for fire service access and for evacuation as well as provisions for people with a disability.

Section 1007 presents requirements for accessible means for egress and describes various components as being; accessible routes, exit stairways with vertical exit enclosures, exterior exit stairways, lifts, platform (wheelchair) lifts, horizontal exits, ramps and areas of refuge.

In regard to lifts:

- Section 1007 requires buildings over 120 feet high to have a fire service access lift for use by the fire service and the lift must open on to a lobby of at least 150 ft² that has a smoke barrier with a one hour fire rating except for doors which are to have a 15 minute fire rating. The lobby is to have direct access to an exit enclosure and the lift must also have a reliable power supply.
- Section 3008 now allows public service lifts to be used for egress of occupants in high-rise buildings. This is not a requirement but is permitted. The elimination of an extra exit stairway is also permitted for high-rise buildings with some limitations and additional requirements including the following:
 - The building having a fire safety and emergency plan.
 - The building having a sprinkler system.
 - The lobby catering for 25% of the people on the storey.
 - The lobby having one wheelchair space for each 50 people on the storey.
 - The lobby having two-way communication system and instructions.
 - There being appropriate signage.
 - There being lift status indication.
 - The lobby enclosure having a vision panel on to the storey.
 - There being central monitoring of the lifts and remote recall ability.
 - The other provisions described for a lobby in Section 1007 above.

Section 1007 also permits platform lifts to be used during egress as well as areas of refuge. Any refuge must have specific provisions including direct access to an exit stairway, be of a minimum size, be isolated with a smoke proof barrier, appropriate signage and have 2-way communication.

A.8.2 National Fire Protection Association (USA)

The National Fire Protection Association (NFPA) publishes the Building Construction and Safety Code NFPA5000 2012, which is a voluntary model building code.

The code addresses components of egress including provision of refuge areas, which may be used as a part of any required means of egress. These refuge areas must be accessible by an 'accessible means of egress' which, in essence, is one that is able to accommodate people with severe mobility impairment. A complying lift may be used as an accessible means of egress.

Also, each refuge area must be sized to accommodate one wheelchair space (approx. 1m²) for each 200 occupants and be fire separated (minimum 1 hour).

Lifts are not included as a general component of an egress system, but may be used as a second means of egress.

NFPA also publish NFPA 101 Life Safety Code 2012 which addresses those construction, protection, and occupancy features necessary to minimise danger to life from fire, including smoke or fumes. The standard does not address the general fire prevention or building construction features that are normally a function of fire prevention codes and building codes, the prevention of injury incurred by an individual due to that individual's failure to use reasonable care or the preservation of property from loss by fire.

The Egress Facilities section establishes minimum criteria for their design.

A.8.3 NIST Building and Fire Research Laboratory (USA)

The NIST Building and Fire Research laboratory web-site provides substantial information on the topic of emergency evacuation. Some of this information is derived from the NIST World Trade Centre Investigation, which resulted in the development of a number of proposals for change to building codes.

A range of papers from NIST researchers include the following:

- Reported findings of the World Trade Centre Investigation included the following comments on occupants with mobility impairments:
 - Approximately 1000 surviving occupants had a limitation that impacted their ability to evacuate.
 - The most frequently reported disabilities were recent injuries and chronic illnesses.
 - The number of occupants requiring the use of a wheelchair was very small relative to the frequency of other mobility impairments.
 - The existing evacuations procedures did not account for all mobility impaired occupants.
- Conclusions with respect lifts:
 - That lifts will play a key future role in both fire fighter access and building occupant egress, particularly for mobility challenged-occupants.
 - That new technologies to facilitate emergency evacuation in buildings are evolving and some believe that the ability to provide reliable power, sophisticated operational protocols, and real time monitoring of critical functions, permits the use of protected lifts as a primary means of egress in fires.
 - While the primary strategy for the safety of building occupants in emergencies is their relocation to a safe place, there is growing support for the use of lifts as a component of an emergency egress strategy.
 - A typical metric for lift efficiency design in modern high-rise commercial buildings has been proposed as total evacuation by lifts in less than one hour.

The NIST, the lift industry, the American Society of Mechanical Engineers (ASME), and the building code organisations were reported as putting considerable effort into the development of standards and code requirements for protected lifts both for fire service access and for occupant egress.

Views differ on refuge storeys and it is reported that initial experience indicates the provision of these areas as a means of occupants transferring between egress systems has merit; however the provision of large areas in which occupants can rest can delay evacuation and potentially influence occupant safety. Those who differ on refuge storeys see merit in considering protected horizontal transfer corridors linking all exit stairways on the plant room levels.

A.8.4 American Society of Mechanical Engineers

Lift use in the USA is governed by the American Society of Mechanical Engineers ASME A17 'Lift and Escalator Safety Package' when adopted at the local level.

In March 2004, the ASME conducted a workshop on the use of lifts for both fire-fighter access and building occupant egress in fires and other emergencies. The workshop topics included:

- Emergency operation of lifts in North America and Europe.
- Pre-planning for use of lifts during emergencies.
- Consequences of smoke migration through lift shafts.
- Fire service control of lifts in emergencies.
- Comparison of the use of lifts and stairs in emergencies.
- Feasibility of using lifts to evacuate tenants of high-rise buildings in emergencies.

Significant points in the papers presented at the Workshop included:

- Regulators, designers and owners being open to change regarding the overall egress system relied upon for a wide range of emergencies.
- Impediments to using lifts for evacuation appear to be more attitudinal than technical.
- Evacuation by lift during the crucial time prior to activation of Phase 1 controls is a viable option for people with mobility impairments.
- An algorithm for total building egress can solve the problem of removing the most numbers of people in the least amount of time.
- The features of protected lift systems that can provide safe and reliable operation both for fire service access and for occupant egress during fires include water tolerant components, fail-safe power, lobbies on each storey designed as areas of refuge, smoke protection, occupant communications, and real time monitoring of the lift position and operating conditions from the fire command centre.
- Many issues need to be solved before changing building codes including: power supply, water, smoke, crowding, number of lifts and escape time utilisation.

Assuming that all technical issues are solved, the procedure to use lifts during an actual fire emergency becomes the most critical element to consider.

A.8.5 Society of Fire Protection Engineers (USA)

In March 2012, the Society of Fire Protection Engineers released a draft document for public review titled 'Guidelines for Designing Fire Safety in Very Tall Buildings'. Although this is a discussion document at the time of publication of this Information Handbook, the draft document contains useful information on all the pertinent issues. It covers the following:

- Unique features of tall buildings.
- Hazard, risk and decision analysis in very tall building design.
- Integration of building systems.
- Reliability of systems.
- Situation awareness.
- Emergency egress.
- Fire resistance.
- Fire suppression.
- Fire detection and alarm.
- Smoke control.
- First responder issues.
- Buildings under construction.
- Building life cycle management.
- Commissioning.
- Inspection, testing and maintenance.

Appendix B Glossary of Terms

ABCB means the Australian Buildings Codes Board.

Assessment Method is an NCC definition and means a method used for determining that a Compliance Solution complies with the Performance Requirements.

Class 1: one or more buildings which in association constitute—

- (a) Class 1a — a single dwelling being—
 - (i) a detached house; or
 - (ii) one of a group of two or more attached dwellings, each being a building, separated by a fire-resisting wall, including a row house, terrace house, town house or villa unit; or
- (b) Class 1b —
 - (i) a boarding house, guest house, hostel or the like—
 - (A) with a total area of all floors not exceeding 300 m² measured over the enclosing walls of the Class 1b; and
 - (B) in which not more than 12 persons would ordinarily be resident; or
 - (ii) 4 or more single dwellings located on one allotment and used for short-term holiday accommodation, which are not located above or below another dwelling or another Class of building other than a private garage.

Class 2: a building containing 2 or more sole-occupancy units each being a separate dwelling.

Class 3: a residential building, other than a building of Class 1 or 2, which is a common place of long term or transient living for a number of unrelated persons, including—

- (a) a boarding house, guest house, hostel, lodging house or backpackers accommodation; or
- (b) a residential part of a hotel or motel; or
- (c) a residential part of a school; or
- (d) accommodation for the aged, children or people with a disability; or
- (e) a residential part of a health-care building which accommodates members of staff; or
- (f) a residential part of a detention centre.

Class 4: a dwelling in a building that is Class 5, 6, 7, 8 or 9 if it is the only dwelling in the building.

Class 5: an office building used for professional or commercial purposes, excluding buildings of Class 6, 7, 8 or 9.

Class 6: a shop or other building for the sale of goods by retail or the supply of services direct to the public, including—

- (a) an eating room, café, restaurant, milk or soft-drink bar; or
- (b) a dining room, bar area that is not an assembly building, shop or kiosk part of a hotel or motel; or
- (c) a hairdresser's or barber's shop, public laundry, or undertaker's establishment; or
- (d) market or sale room, showroom, or service station.

Class 7: a building which is—

- (a) **Class 7a** — a carpark; or
- (b) **Class 7b** — for storage, or display of goods or produce for sale by wholesale.

Class 8: a laboratory, or a building in which a handicraft or process for the production, assembling, altering, repairing, packing, finishing, or cleaning of goods or produce is carried on for trade, sale, or gain.

Class 9: a building of a public nature—

- (a) **Class 9a** — a health-care building, including those parts of the building set aside as a laboratory; or
- (b) **Class 9b** — an assembly building, including a trade workshop, laboratory or the like in a primary or secondary school, but excluding any other parts of the building that are of another Class; or
- (c) **Class 9c** — an aged care building.

Class 10: a non-habitable building or structure—

- (a) **Class 10a** — a non-habitable building being a private garage, carport, shed, or the like; or
- (b) **Class 10b** — a structure being a fence, mast, antenna, retaining or free-standing wall, swimming pool, or the like; or
- (c) **Class 10c** — a private bushfire shelter.

Compliance Solution means a solution which complies with the Performance Requirements and is—

- (a) a Performance Solution; or
- (b) a solution which complies with the DtS Provisions; or
- (c) a combination of (a) and (b).

DtS Provisions (or DtS) is an NCC definition and means provisions which are deemed to satisfy the Performance Requirements.

Egress lift means a lift suitable for occupants to egress a building safely during an emergency. It is likely to also be a passenger lift under normal operating conditions and also an emergency lift if for use by emergency services personnel.

Emergency lift is an NCC definition and means a lift for use by emergency services personnel in an emergency but may also be a passenger lift under normal operating conditions.

Emergency services personnel means people authorised by the State or Territory government, including emergency services personnel, or by the building owner, to rescue building occupants.

Equivalent is an NCC definition and means equivalent to the level of health, safety and amenity provided by the DtS Provisions.

Evacuation route is a NCC definition and in short, means the continuous path of travel (including exits, public corridors and the like) from any part of a building, including within a sole-occupancy unit in a Class 2 or 3 building or Class 4 part, to a safe place.

Evacuation time is an NCC definition and means the time calculated from when the emergency starts for the occupants of the building to evacuate to a safe place.

Expert Judgement is an NCC definition and means the judgement of an expert who has the qualifications and experience to determine whether a Compliance Solution complies with the Performance Requirements.

Exit is an NCC definition and means—

- (a) Any, or any combination, of the following if they provide egress to a road or open space-
 - (i) An internal or external exit stairway.
 - (ii) A ramp.
 - (iii) A fire-isolated passageway.
 - (iv) A doorway opening to a road or open space.
- (b) A horizontal exit or a fire-isolated passageway leading to a horizontal exit.

Fire control centre means a place in a building that is constructed in accordance with Specification E1.8 from where fire-fighting operations or other emergency procedures can be directed or controlled; and contain controls, panels, telephones, furniture, equipment and the like associated with the required fire services in the building.

Fire-isolated exit stairway means an exit stairway within a fire-resisting shaft and includes the floor and roof or top enclosing structure.

Fire-isolated passageway is an NCC definition and means a corridor, hallway or the like, of fire-resisting construction, which provides egress to or from a fire-isolated exit stairway or fire-isolated ramp or to a road or open space.

Fire-isolated ramp is an NCC definition and means a ramp within a fire-resisting enclosure which provides egress from a storey.

Functional Statement is a NCC definition and means a statement which describes how a building achieves the Objective.

NCC means the National Construction Code.

Nominated floor means the storey designated by the appropriate authority, and contained in the building's emergency plan, for persons to leave the lift in order to safely exit the building.

Objective is an NCC definition and means a statement contained in the BCA which is considered to reflect community expectations.

Passenger lift means a lift for use by building occupants to access a building under normal occupancy conditions.

Performance Requirement is an NCC definition and means a requirement which states the level of performance which a Compliance Solution must meet.

Performance Solution is an NCC definition and means a Compliance Solution which complies with the Performance Requirements other than by reason of satisfying the DtS Provisions.

Safe place is an NCC definition and means—

- (a) a place of safety within a building—
 - (i) which is not under threat from a fire; and
 - (ii) from which people must be able to safely disperse after escaping the effects of an emergency to a road or open space; or
- (b) a road or open space.

Shaft is an NCC definition and means the walls and other parts of a building bounding—

- (a) a well, other than an atrium well; or
- (b) a vertical chute, duct or similar passage, but not a chimney or flue.

Verification Method is an NCC definition and means a test, inspection, calculation or other method that determines whether a Compliance Solution complies with the relevant Performance Requirements.

Appendix C List of Relevant Documents

The following list of useful reference material has been provided by contributors to this Information Handbook.

AS1668.1 (1998) 'The use of ventilation and airconditioning in buildings Part 1 – Fire and smoke control in multi-compartment buildings', Standards Australia.

AS 1670.1 (2004) 'Fire detection, warning, control and intercom systems – System design, installation and commissioning Part 1 – Fire', Standards Australia.

AS 1670.4 (2004) 'Fire detection, warning, control and intercom systems – System design, installation and commissioning Part 4 – Sound systems and intercom systems for emergency purposes', Standards Australia.

AS 1851 (2012) "Routine testing of fire protection systems and equipment", Standards Australia.

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AS 3745 (2010) 'Planning for emergencies in facilities', Standards Australia.

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Guideline GL-07: 'Single Fire Isolated Stair in High-Rise Building'. Metropolitan Fire and Emergency Services Board.

Guideline GL-18: 'Evacuation of High-Rise Buildings'. Metropolitan Fire and Emergency Services Board.

Guideline GL-31: 'Use of Lifts for Evacuation'. Metropolitan Fire and Emergency Services Board.

International Building Code (IBC) (2012), International Code Council (ICC).

ISO/TR 25743: 2010(E) 'Lifts (elevators) – Study of the use of lifts for evacuation during an emergency', International Standards Organisation.

ISO /IEC Guide 71 (2002) 'Guidelines for standards developers to address the needs of older persons and persons with disabilities', International Standards Organisation.

'International Building Code (IBC)' (2012), International Code Council (ICC).

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Appendix D Commonwealth, State & Territory Contacts

Contact details for the States and Territories can be found on the ABCB website at www.abcb.gov.au.