PRP

Fire Safety: Specialised Housing and Care Homes

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Executive Summary

Since the inception of sheltered housing during the 1950's in the UK, a range of specialised housing and care home types have evolved creating a variety of building typologies across the sector in response to societal change. Better health and social care in the post-war years has resulted in people living longer, often associated with more complex needs, disabilities and/or impairments. The increase in life expectancy and the desire of those in their later years to live as independently as possible, for as long as possible has therefore resulted in a spectrum of housing and care options across the sector, providing differing levels of onsite care and support.

This research considers the different specialised housing and care home typologies which exist in England today and whether the current Building Regulations guidance Approved Document B (ADB) Volume 1 'Dwellings' & Volume 2 'Buildings other than Dwellings'[1] provide adequate guidance in terms of fire safety for each typology. The research has also reviewed other sector specific guidance and documentation relevant to this sector, which in many cases go into more detail and make recommendations beyond those in ADB, to consider the evidence base and effectiveness for these. The research included a survey of building owners across the typologies, review of relevant guidance and literature on specialist housing in the UK and a review of International regulations to ascertain best practice from a selection of other countries.

The analysis was carried out based on the following building typologies:

- Retirement housing, also known as retirement living, sheltered housing or independent living, which are age-restricted independent dwellings designed to be 'care-ready' for older people;
- Housing with care, also known as extra care, assisted living or integrated retirement communities, are independent dwellings designed for older people where care and support can be provided, as required, to suit resident needs;
- Supported housing type 1, which are independent dwellings designed for people of all ages where support can be provided, as required, to suit resident needs;
- Supported housing type 2, also known as group homes, which are houses or apartments where residents live communally with a shared kitchen, lounge and assisted bathroom, with support provided, as required, to suit resident needs;
- Care homes, also known as nursing homes or specialised care homes, which comprise a series of bedrooms clustered around shared living accommodations, including a dining room and lounge.

Prevalence of fire engineered solutions. Through a series of desktop case study reviews across all of these typologies, surveys completed by operators and detailed interviews with those managing fire safety across the building typologies, this work has uncovered some disconnect between the design of and construction of the buildings under the current ADB and the actual fire safety management of the premises, particularly in relation to evacuation procedures. The prevalence of fire engineered solutions across many of the case studies suggests that ADB does not provide sufficient practical guidance on ways to achieve compliance for the range of typologies in actual use.

Assistive technology devices. Assistive technology, which assists some residents with hearing or visual impairments when fire alarms are activated, are currently not included within ADB guidance.

Mobility scooters. Guidance on mobility scooters can currently be found in the NFCC's 'Mobility Scooter Guidance for residential buildings' report, but the ADB does not provide any guidance on the use, charging and storage of mobility scooters within buildings. BS 9991 provides limited advice on the storage and charging for these scooters, but does not differentiate between these and electric wheelchairs. Whilst there have been relatively few recorded instances of fires being caused by mobility scooters, in fire situations these can release large volumes of toxic smoke and generate significant heat outputs. There are also existing concerns about the spread of mobility scooter fires to other scooters due to exponentially increased heat rates.

Definitions. The research also uncovered the need to provide better clarity around how the various specialist housing and care home typologies are defined in ADB. The current residential classifications

1 *Building Regulations, Approved Document B Part B Volume 1 & Volume 2 (HM Government, 2010).*

differentiate between dwellings and institutional settings, but do not adequately define care in dwellings, for instance flats with habitual specialised care, housing with care and some forms of supported housing. For example, the reference to retirement housing, i.e. sheltered housing for portions of ADB creates a hybrid scenario between parts of the technical guidance regulations, but ABD is silent on the housing with care and Supported Housing Type 1 typologies, leaving these more open to interpretation and leading to inconsistencies across the sector. One example where this may be important is fire alarms. The specialised housing typologies sit in a 'grey' zone between general needs housing and care homes, and a hybrid approach often needs to be taken for both the design and management of these buildings. Independent dwellings currently require a fire alarm system designed to BS 5839-6, but retirement housing and housing with care would be required to have common parts that have an alarm system designed to BS 5839-1. Supported housing type 1 consists of independent dwellings, but is also required to have a fire alarm system designed to BS 5839-6.

Increasing development sizes. The supported housing type 2 and care home typologies fall under Purpose Group 2(a) Residential Institutional. ABD currently makes specific recommendations for these types that reflect the needs of the residents and the management regime in the building. However, it must be noted that, since the inclusion of means of escape measures relating to care homes in 1992 and the reference to sprinklers in 2006, the scale of care homes now being developed has increased in overall size and number of bedrooms. It is therefore recommended that the assumptions for the current ADB guidance are reviewed to reflect the current situation.

Stay put vs. partial evacuation. The specialised housing typologies within the scope of this report tend to follow the evacuation strategy for ADB Purpose Group 1 for general needs dwellings, which is to utilise a 'stay put' policy within the recommended compartmentation guidelines. In practice, however, for retirement housing and housing with care, a level of partial evacuation is often also allowed for by building owners for additional flexibility for evacuation of residents, with cross-corridor compartmentation and phased alarm systems. Under ADB guidance for apartments, cross-corridor doors have not been included to deal with this partial evacuation approach and, with no safe place of refuge away from the corridor, evacuees could obstruct the route needed for effective firefighting. Refuge points within stair cores are likewise not a requirement under ADB for specialised housing typologies but are often provided at the request of the Building Control body.

Evacuation strategies for Residential Institutional typologies. ADB includes indicative guidance for progressive horizontal evacuation in care homes. However, from industry engagement and experience in the sector further clarity is needed on the provision of protected areas where bedrooms are in a dead-end condition and the acceptability of stairs as protected areas sufficient to accommodate the adjacent compartment resident population evacuating. There is no specific mention in ADB of requirements for care home stairs to accommodate vertical evacuation. More evidence is required regarding the determination of the allowable number of bedrooms (currently set at a maximum of 10) within a protected area, utilising predicted staffing levels, time to evacuate a compartment and resident needs.

International comparisons. In addition, through reviewing regulations from a selection of other countries, comparisons have been drawn on alternative approaches to fire safety for specialised housing and care home design. Countries which have a more mature later living market as compared to the UK, often have greater detail around classification for the building typologies, including the levels of need and care associated with each. A more prescriptive, 'deemed to comply' approach was also evident where classification of specialist housing and care typologies was evident, particularly in relation to the use of sprinklers, compartmentation, levels of fire resistance and means of escape. Such a robust and consistent approach to building typology classification, firmly grounded in an understanding of operational fire management and staffing realities, could in turn be distilled into a set of more consistent, defined ways to achieve compliance in England, reducing the reliance on fire engineering across the typologies.

Recommendations

Some of the research has proved to be inconclusive due to the range of building typologies as well as the complexity and scope of the project. The variations observed in practice and the limitations of the sample case study visits has resulted in some of the statistical results being indicative and more of a qualitative nature than quantitative.

Based on the findings outlined within this report, recommendations for further research have been made which include the following:

- Consider if specialised housing should have a separate designation within the technical guidance regulations and review how the route to compliance for each would work.
- Review the effectiveness of evacuation strategies to ascertain the suitability of the current means of escape and compartmentation for modern specialised housing and care homes.
- Review the provision of sprinkler systems in buildings, of all heights and types, in the specialised housing and care home sector.
- Review the safe storage of mobility scooters in terms of level of provision, the design of and technical specification of storage.

1. Introduction

1.1. Research Project Summary

1.1.1. The overall objective of this research project is to generate the knowledge and evidence needed to make informed, evidence-based policy decisions. The research was originally commissioned by the Department for Levelling Up, Housing and Communities, and subsequently the oversight of the contract was transferred to the Building Safety Regulator within the Health and Safety Executive. The research considers whether Approved Document B ("ADB")[2] provides adequate guidance, in relation to the building types being considered by this project, to meet the minimum functional requirements under Schedule 1 Part B of the Building Regulations 2010.

1.1.2. There are two parts to the project objectives comprising:

Objective 1
a) An initial scoping exercise, identifying current evidence, and providing an overarching appraisal across different types of specialised housing and care homes. The current building typologies are defined and reviewed in terms of modern building design approaches, technology application, as well as building use and operation.

b) A review of the current guidance in ADB, including the basis for the provisions, how they are used in practice and how the approach considers the findings in the 1a) scoping exercise, as well as current and anticipated changes in the specialised housing and care home sector.

Objective 2
Using the findings from Objective 1, Objective 2 then formed the next stage of the research, identifying and analysing potential alternative approaches and policy options, generating evidence, understanding and knowledge for consideration in future policy development. Objective 2 is split into two definitive instructions as outlined in the final sections of this report.

1.1.3. The building types considered in this report are specialised housing (including supported, sheltered and extra care housing for elderly and otherwise vulnerable residents) and care homes. These building types will be further defined in this report.

1.1.4. The research team consists of PRP, Innovation Fire Engineering and Adroit Economics. A Technical Steering Group and Research Focus Group have been established.

1.1.5. This report is set out chronologically and summarises the findings of the Objective 1 research and analysis followed by the subsequent instructions and findings for Objective 2 research.

2 *Building Regulations, Approved Document B Part B Volume 1 (HM Government, 2010).*

2. Objective 1: Research Approach

2.1. Methodology

2.1.1 The research approach was set out in the Research Methodology report of June 2020.

2.1.2 The collected data relates to residential care homes and specialised housing only. General needs and other housing types were omitted as these typologies are outside of the project scope.

2.1.3 The data has been sourced from multiple sources including existing published research as well through direct engagement with relevant third parties. The research team has not been able to gather all of the data it wished to due to a number of reasons, including Covid-19 at the time of writing this report, third parties being wary about releasing information that would be reviewed in relation to fire safety and the full required research data not being collected at the time of a fire incident. Where this has occurred, alternative data methods have been explored and utilised to ensure the robustness of the data being assessed.

2.1.4 As an example, fire-related fatality datasets record the age of victims, cause of fire, and whether a fire was in a dwelling or other building, but it will not specify the building typology. Conversely, other fire datasets will specify the building type with only a marker for fatalities or casualties and not the victim's age or occupancy status.

2.1.5 Fire incident and related research datasets, reports and guidance have been collected from the following organisations and authorities:

1. Home Office
2. London Fire Brigade (LFB)
3. National Fire Chiefs Council (NFCC)
4. Association of Retirement Housing Managers (ARHM)
5. BRE Global
6. Innovation Fire Engineering

2.1.6 Additional data has also been sourced from Fire and Rescue Authorities.[3] The Home Office's department of Analysis and Insight for Fire Statistics has stated that it does not publish data on the age of the casualties by type of building (other than for dwellings and the general 'other building' category[4]).

2.1.7 Along with the data gathered from the fire services and government departments, the research team authored a questionnaire survey aimed at obtaining specific data on the occupancy, residents' profile, building design, operational issues and management of the relevant building typologies. We have also collected data and evidence from published research reports and industry publications. These are listed in Appendix 3 of this report. In addition, we were able to collect data on relevant fire safety legislation and approaches to specialised housing building design from some international countries, including Australia, USA (Florida) and New Zealand.

2.1.8 Furthermore, a comparison of the principal guidance documents was undertaken which included Approved Document B, BS9991[5] and BS9999[6] which can be found in Appendix 4 of this report, as well as establishing why the existing guidance in ADB relevant to care homes and specialised housing was introduced.

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3 The following 8 Fire and Rescue Authorities we contacted: Humberside; West Yorkshire; Lincolnshire; Greater Manchester; Tyne & Wear; West Midlands; Hertfordshire; Suffolk.

4 The 'other building fires' dataset has a variable for building type, which includes nursing/care homes, other residential homes etc.

5 BSI, BS9991: 2015 Fire Safety in the design, management and use of residential buildings (BSI, 2015).

6 BSI, BS9999: 2020 Code of practice for fire safety in the design, management and use of buildings (BSI, 2020).

2.2 Building Typologies

2.2.1 The relevant building types within the scope of the research have been categorised into five different typologies, with a sixth typology included for those developments which have a mixture of more than one type. Table 1 below lists and defines the six building typologies:

Table 1: Building Typology Definitions

1. Retirement Housing

Also known as	Care & Support Provision	Definition	Resident Profile
• Retirement living • Sheltered housing • Independent Living • Alms houses	• No on-site care • Visiting scheme manager	Age restricted, independent dwellings designed to be 'care-ready' for older people. The size of developments can vary greatly from 20 units to larger retirement villages. Developments may include a mix of apartments, bungalows or cottages. Communal accommodation is minimal, usually a resident's lounge.	Aimed at active older people who need no or little care or support (55 years +).Any care required in later years would be provided on an ad-hoc basis, similarto people living within wider community.

2. Housing with Care

Also known as	Care & Support Provision	Definition	Resident Profile
• Extra care • Very sheltered • Assisted living • Close care • Independent living • Integrated retirement community	• 24-hour on-site care Scheme manager(s) duringworking week	Independent dwellings designed for older people where care and support can be provided, as required, to suit residents' need. For viability reasons, new build developments are usually 60+ dwellings and more commonly apartments. A range of communal facilities is provided which can include lounge, restaurant, activity room, gym, hair salon, therapy and even a swimming pool. The provision of these is dependent on tenure, size and location. The building is not registered with the Care Quality Commission (CQC) but the care operator will be a CQC registered domiciliary care provider.	Average age of residents entering is late 70's and average age of residentsliving within developments is 82-85 years old*. The level of care need is normally spilt into 1/3 of people requiring minimal levels of care, 1/3 requiring medium levels and a 1/3 requiring high levels. * International Longevity Centre UK

3. Supported Housing Type 1

Also known as	Care & Support Provision	Definition	Resident Profile
	• Scheme manager and keyworkers	Independent dwellings designed for people of all ages where supportcan be provided, as required, to suit residents' need. Communal accommodation is usually a small resident's lounge with kitchenette. The building is not registered with CQC.	All ages of residents. Can provide for arange of impairments or disabilities such as Autism, Learning Disabilities, Mental Health issues.

4. Supported Housing Type 2

Also known as	Care & Support Provision	Definition	Resident Profile
• Group homes	• Scheme manager and keyworkers	House or apartment where residents live communally with shared kitchen, lounge and assisted bathroom - akin to a small care home. Residents usually have their own bedroom and ensuite bathroom. Support is provided, as required, to suit residents' need. The building is likely to be CQC registered.	All ages of residents. Can provide for arange of impairments or disabilities such as Autism, Learning Disabilities, Mental Health.

5. Care Home			
Also known as	Care & Support Provision	Definition	Resident Profile
• Nursing home • Residential carehome • Specialised carehome	• 24-hour on-site care, support & management forall residents. • Nursing care is provided to nursing homes. • May include some recuperative care	Care homes comprise a series of bedrooms (usually with ensuites) clustered around shared living accommodation, including a dining room and lounge. For viability reasons developments normally have 60+ bedrooms. Residents do not live independently due to their level of frailty and higher need for care. All meals are provided and the whole building is staffed 24 hours a day. The building is registered with CQC.	Residents are those requiring long termcare as a result of either physical frailty, Dementia or the need for nursing care. Residents are typically over 85 years.

6. Mixed Typologies			
Also known as	Care & Support Provision	Definition	Resident Profile
• See above for range of typologies	• Varies depending on which of the above typologies are included.	Could include one or more of the above	Residents profile will vary across the development depending on which of the above typologies are included.

2.2.2 There are multiple terminologies adopted across the specialised housing and care home sectors and to avoid confusion these are outlined in the 'also known as' column. The above includes terminology used within both the ADB and BS9991[7].

2.2.3 As the mixed typologies comprise two or more of the other typologies, it is not defined as a separate typology within the survey data obtained. Where data relevant to mixed typologies has been collated these have been responded to for each individual typology.

2.2.4 Within the current Building Regulations Approved Document B (Fire Safety), the provisions within "Table D1: Classification of Purpose Groups" categorise the use of a building representing different levels of hazard and anticipated use. The classification may apply to the whole building or parts of a building where it is separated from other parts with other uses, making the purpose and levels of hazard specific to the parts being defined. The building typologies utilised within this research scope fall within the following two Purpose Groups, namely; Group 1: Residential Dwellings and Group 2(a): Residential Institutional as set out in Approved Document B (Fig. 2).

2.2.5 Whilst these residential classifications do differentiate between dwellings and institutional settings as highlighted in Figure 1, their definitions do not define care in dwellings, for instance flats with habitual specialised care, as seen in retirement housing, housing with care and supported housing type 1. Some reference is made to sheltered housing (typology 1) and how some aspects of ADB Volume 2 should be considered for common areas.

7 *BSI, BS9991:2015 Fire Safety in the design, management and use of residential buildings (BSI, 2015).*

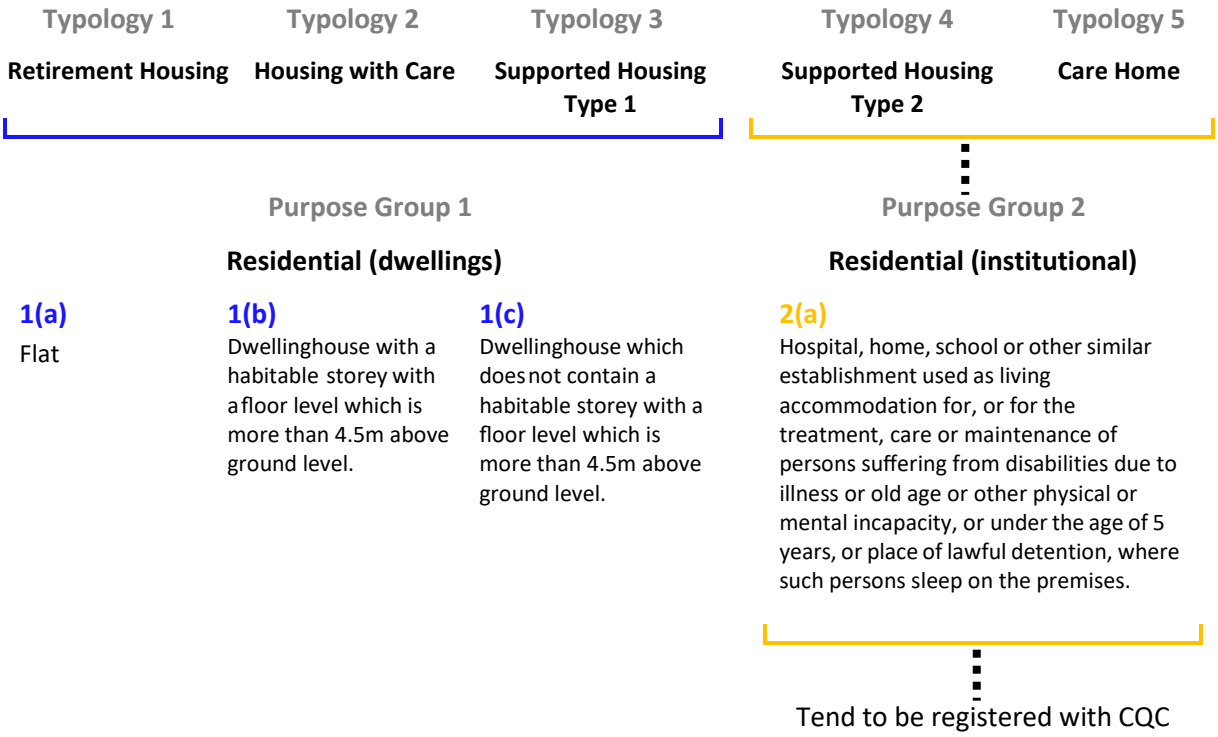

Figure 1: Typologies as defined within Table 1 mapped against Purpose Groups as defined in Table D1 of ADB

2.3 Current and Predicted Care Provision & Needs

"In 2015, more than 350,000 older people in England were estimated to use home care services, 257,000 of whom had their care paid for by their local authority. A further 76,300 younger people with learning disabilities, physical disabilities or mental health problems were also estimated to be using publicly funded home care.

The United Kingdom Homecare Association (UKHCA) estimates that around 249 million hours of home care are delivered in England each year (Holmes 2019)."

Extracts from Home Care in England, Kings Fund December 2018

2.3.1 In the extract above, the stated figures refer to domiciliary care provision i.e. care services provided to people in their own homes, which includes those receiving care within private homes and a specialised housing setting (i.e. typologies 1, 2 & 3). With supported housing type 2 and care homes (typologies 4 & 5), the buildings and the services provided within them are registered with the Care Quality Commission (CQC). Care provided within typologies 4 & 5 would not therefore be provided by domiciliary care providers and is excluded from the figures above.

2.3.2 Older households are growing at a much faster rate than the rest of the population. The growth in older households will increase demand for social care and health care, place further pressure on specialised housing. Projections by the London School of Economics and the Personal Social Services Research Unit, at constant 2015 prices using a set of base case assumptions about trends in the drivers of long-term care demand and in the unit costs of care services, have estimated the public expenditure on social services to be as follows: [8]

- For older people, a rise under the current funding system from around £7.2 billion (0.45% of GDP) in 2015 to £18.7 billion (0.75% of GDP) in 2040
- For younger adults a rise under the current funding system from around £8.9 billion (0.55% of GDP) in 2015 to £21.2 billion (0.85% of GDP) in 2040.

8 *Hu, et al., Projections of Demand and Expenditure on Adult Social Care 2015 to 2040 (LSE, 2018).*

2.3.3 The Elderly Accommodation Counsel has estimated that 90% of supported units for older people are sheltered housing (typology 1), with the remaining 10% being for extra care (typology 2). Specialised housing (typologies 3 & 4) is also required for working age people including vulnerable persons, those with disabilities, those with mental health problems, those at risk of domestic abuse, people with drug or alcohol misuse needs, among others.

2.3.4 It is estimated that there are currently 735,000 senior housing dwellings (affordable, private and rented) across the UK. Due the significant demographic growth of the over 65s, the number of dwellings is due to increase by 10% taking overall stock to over 800,000 by 2024. The number of retirement housing units (typology 1) has risen by more than 21,000 units (16,000 private, 5,000 affordable) in the last five years (an increase of 3%). By comparison, 23,700 housing with care units (typology 2) have been built (10,000 private, 13,700 affordable) over the same time (an increase of 35%)[9].

2.3.5 This data provides a good background to understanding the demand and the need across England for these specialised forms of accommodation. However, it does not provide detail on occupant profiles within the buildings regarded to be in the scope of this project, and occupant's ability to escape in the event of a fire.

2.4 Resident Profiles

2.4.1 The NFCC have highlighted that *"Most deaths from fire occur in dwellings; a disproportionate number of such deaths from fire occur in blocks of flats and multiple occupancy dwellings. Those living in specialised housing can be amongst the most vulnerable to hazards such as fires. Compliance with the Building Regulations alone is not necessarily sufficient to address the protection of vulnerable residents from fire."*[10] It was therefore considered important to gain an understanding of the profile of residents likely to be living in the buildings, to ascertain how their behaviour and use of the buildings may have an impact on ADB

2.4.2 A survey questionnaire was sent by the research team to a range of specialised housing and care home providers in England, with responses being received from over 100 different building managers across the range of typologies. Their responses provide insight into the trends in occupancy demographics, assistance needs in evacuation situations, along with data to fill gaps observed in other data sets we have collected.

2.4.3 Approximately 93 responses were provided in completion, with each specialised housing and care home providers providing a full number count of residents. The sample data collated for the range of typologies and the responses to the questions asked are outlined within Appendix 1 of this document.

2.4.4 Although there has been a significant reduction in the number of fires and related deaths and injuries in dwellings in the last 20 years, a disproportionate number of them involve older people or others with recognisable "contributory factors". Those involved may be elderly, have mobility or medical issues, cognitive impairment or mental health issues. These needs may include, to some degree, the need for care and support services in residential dwellings, which would include typologies 1, 2 & 3, as well as general needs dwellings.

2.4.5 Supported housing type 2 and care homes (typologies 4 & 5) are similar in nature in that they provide for the frailest and most vulnerable cohort of residents. These typologies are fully managed buildings with 24-hour staff where residents do not live independently.

2.4.6 A number of key factors have been explored within the survey to ascertain how likely residents within certain typologies are to be able to escape independently and respond appropriately to fire safety measures within the development. The data depicts that, although a percentage of occupants may be physically fit, residents may have a range of cognitive or other impairments e.g. dementia or learning disabilities, resulting in them requiring assistance.

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9 Harwood, Rising investment to underpin increase in development of seniors housing (Knight Frank, 2020).

10 National Fire Chiefs Council, Fire Safety in Specialised Housing (NFFC, 2017).

2.4.7 The chart below represents how each building typology differs in occupants' needs (Fig. 2), defining the number of hours of care, support or treatment hours a resident would require across an average week.

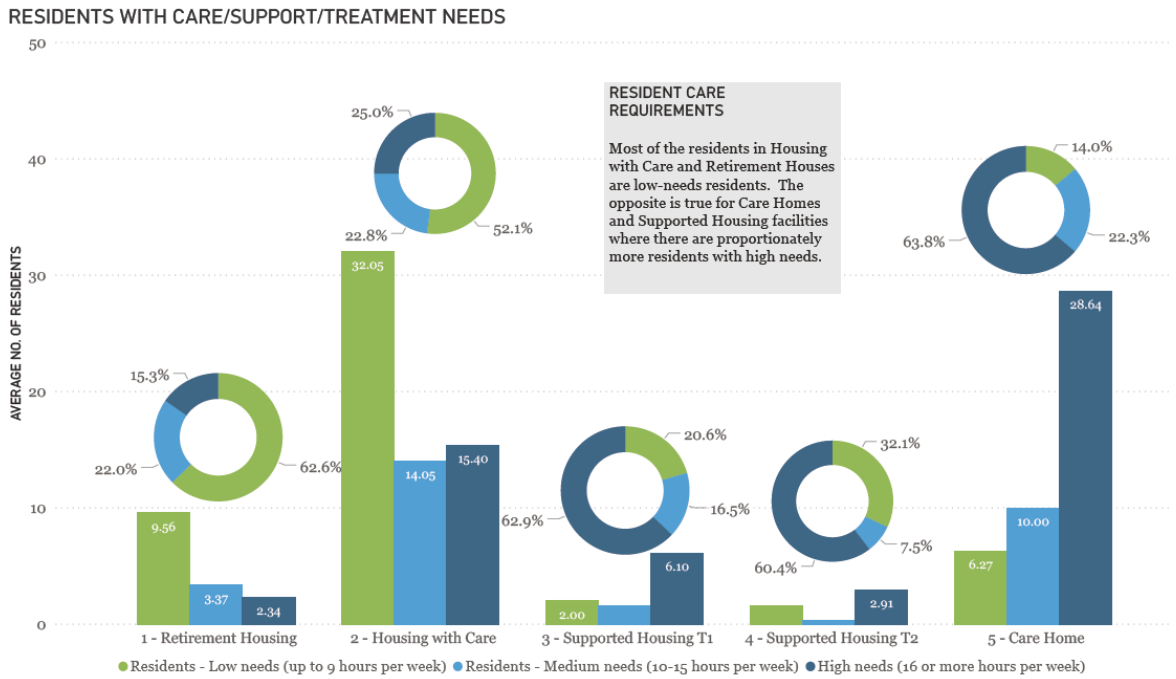

Figure 2: Proportion of Residents with Care/Support/Treatment Needs, Appendix 1 Quantitative Analysis Page 113

2.4.8 Whilst the mobility issues have an obvious impact on a person's ability to self-evacuate in the event of a fire, there is a direct correlation between other cognitive impairments as highlighted on figure 3 below. It is also notable that, as anticipated, those occupants more able to self-evacuate live in the more independent models of housing i.e. typologies 1 & 2 whilst those requiring more assistance live in a care home setting, typology 5. For both the supported housing models, typologies 3 & 4, the data suggests more complex issues with residents requiring assistance due to complexity of their impairments and physical disabilities. The qualitative survey within this research has therefore highlighted how the specific needs of residents in specialised housing, as opposed to those in general needs housing, can impact on their ability to understand alarm soundings and to self-evacuate, creating a reliance on management staff to assist evacuation where required.

2.4.9 Research in 2011 showed that walking speed decreases each year of our life[11]. The older the resident is therefore the slower they will walk. The speed is further reduced by some medical conditions, such as recovery after a stroke. The research established that average walking speeds are:[12]

Age	**Meters per second**
60-69	1.24 -1.34
70-79	1.13 -1.26
80-89	0.94 - 0.97

11 *Schimpl, et al., Association between walking speed and age in healthy, free-living individuals using mobile accelerometry A cross-sectional study (PLoS One, 2011).*

12 *Cronkleton, What is the Average Walking Speed of an Adult? (Healthline, 2019).*

Figure 3: Mobility Impairments Hindering Ability to Escape, Appendix 1 Quantitative Analysis, Pages 118

2.4.10 This data highlights the various impairments within each typology affecting ability to self-evacuate in the event of an alarm activation. Dementia and other cognitive impairments are likely to cause confusion and an inability to understand the purpose of the alarm sounding, whereas hearing impairments would impact on the ability to hear the alarm activation. From the survey data obtained, those people with visual and mobility impairments are likely to require assistance to evacuate due to their physical needs.

2.4.11 In the typologies for older people, the percentage of people who would be unable to self-evacuate is relatively lower within retirement housing when compared to care homes, with housing with care sitting in between both. The type of impairments highlighted are also typically those which would be associated with ageing. This reflects the expectation that those in retirement housing would be the most independent whilst those in care homes are no longer living independently as their care needs are much higher.

2.4.12 Within the supported housing typologies, the range of impairments are often multiple, highlighting the potential complexity of needs for the residents within these typologies. Again, within this sector the expectation by designers and operators is that the complexity of needs for those living in supported housing type 1 would be lower, allowing them to live more independent lives, compared to those requiring higher levels of assistance in supported housing type 2.

Figure 4: Assistance Required to Evacuate, Appendix 1 Quantitative Analysis, Page 120

2.4.13 The graph below (Fig. 5) shows responses to the survey where additional aids or equipment have been installed to assist in the evacuation of residents in the event of an evacuation. This highlights that residents in some building typologies where residents are more likely to have mobility issues, such as care homes, require more physical support from staff compared to other buildings. The presence for these aids depends heavily on the building design, availability of staff and the presence of a fire evacuation lift, as well as the physical frailty of the occupants themselves and their cognitive ability to cooperate in the event of an emergency.

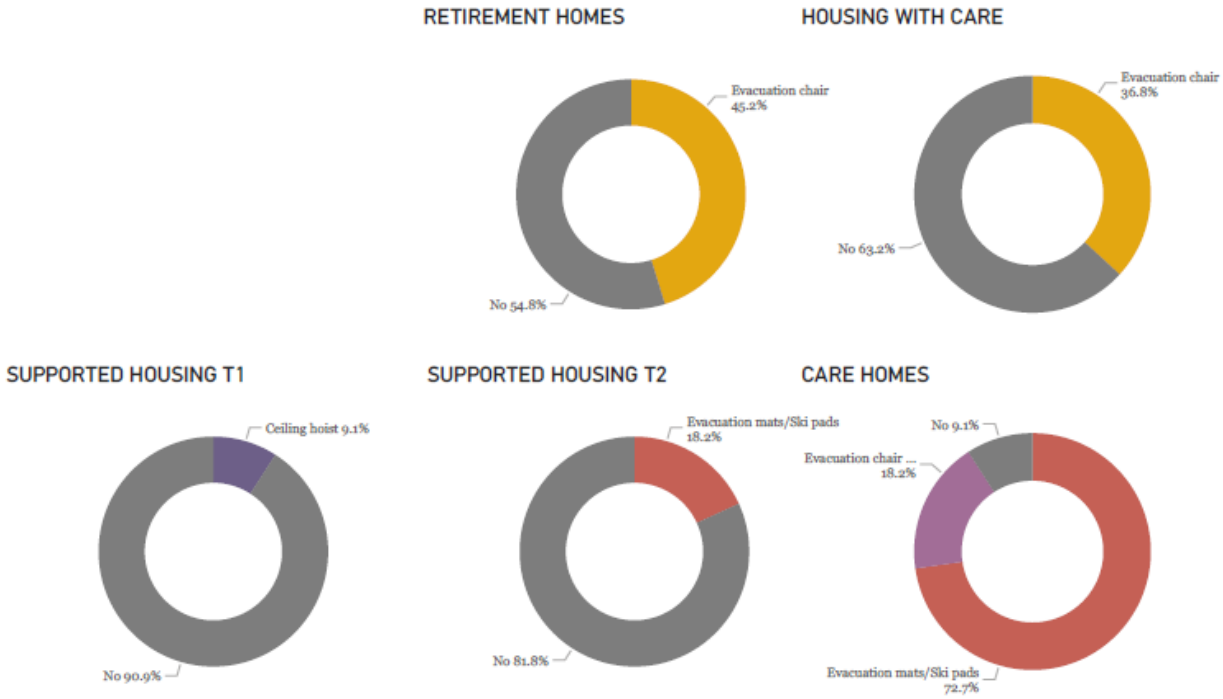

Figure 5: Aids Required to Assist Evacuation: Appendix 1 Quantitative Analysis, Page 127

2.4.14 In conclusion the residents in typologies 4 and 5 have the highest levels of need, often with complex and/or multiple needs. Occupants of these buildings are no longer living independently and are most likely to requiring assistance in the event of an emergency. These typologies fall within Purpose Group 2(a) Residential Institutional within ADB providing guidance which in the main is clearly defined for their resident profile.

2.4.15 Residents in typologies 1, 2 and 3 have varied levels of need which can also change over time. A proportion of the occupants of these typologies will need assistance to escape in the event of a fire situation. These typologies fall within Purpose Group 1 Residential Dwellings within ADB and follow the guidelines for general needs housing, with some additional allowances for sheltered housing (typology 1).

3. History of Current Legislation & Guidance

3.1. This section considers how fire safety legislation for the sector (in this context meaning specialised housing and care homes), together with any guidance and accompanying understanding has developed since the Second World War. The study of this background will contribute to the analysis of the basis of current approaches and help identify gaps and weaknesses for consideration in the project review at large.

3.2. Specialised housing and care homes is a sector with a wide matrix of nomenclature, definitions, and distinctions across an often-shifting scope of buildings.

3.3. Building Regulations

3.3.1. Prior to 1965, local acts and byelaws controlled safety in new buildings and set out detailed technical requirements. In 1965 national Building Regulations came into force and the 1985 Building Regulations set functional fire safety requirements, which were (and continue to be) set out in Part B of Schedule 1 to the Regulations. Approved Document B (ADB) was published under the 1985 Building Regulations to provide statutory guidance on how these requirements could be achieved for common building situations.

3.3.2. *Structural Fire Resistance and Prevention of Fire Spread*
Building Byelaws contained requirements for structural fire resistance and the prevention of fire spread, and these transferred into 1965 national Building Regulations.

3.3.3. *Means of Escape*
Means of escape requirements were not included in the Building Regulations until 1977. At that time, only flats of over 3 storeys were covered, which would apply to typologies 1, 2 & 3. The British Standard document CP3[13] provided a standard for buildings containing flats with no requirements for other forms of residential premises. Therefore, only specialised housing developments over 3 storeys were brought under control at that time. This situation changed marginally under the 1985 switch to functional regulations in that they covered houses and flats over 3 storeys, once again referenced to CP3 standards.

3.3.4. The 1991 edition of the Building Regulations expanded means of escape coverage to all building uses and heights. Approved Document B (ADB) 1992 included guidance for flats and houses, which was formulated on the basis of general needs occupation. This format has continued to date with updating amendments at intervals, and it is this guidance that has been universally applied to the design of specialised housing. General guidance within the Approved Documents does refer to a structured need to consider supplementary measures where necessary for sheltered housing but there is no specific guidance to that end.

3.3.5. ADB 1992 also saw the first specific Building Regulation requirement for means of escape in residential care homes. This drew upon the recommendations contained in hospital 'Fire Code' guidance and the approach was based upon the progressive horizontal evacuation principle. Following the introduction of Regulatory Reform (Fire Safety) Order 2005, the 2006 edition of ADB included enhanced guidance around this principle, including some permitted variations of approach where sprinkler protection is provided.

3.4. Fire Safety and Care Legislation

3.4.1. *Early controls*
Early controls were mainly conducted via local fire services, who were often asked to give fire safety assessments as part the process of registration of residential care homes (typologies 4 & 5). Certain powers were also held by local authorities under the Public Health / Buildings Acts. Both of these routes were applied inconsistently and assessed without the benefit or guidance of national standards.

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13 *BSI, British Standard Code of Practice, CP 3 : Chapter IV : Part I : 1971 (British Standards Institute, 1971, incorporating amendments issued January 1972 (AMD 851), January 1973 (AMD 1077), Feb 1976 (AMD 1889) and August 1978 (AMD 2708))*

3.4.2. The 1983 Home Office 'Draft guide to fire precautions in existing residential care premises'[14] was an important step in consolidating standards. These were formulated from good practice and empirical experience gained from previous assessments of existing buildings and their upgrading needs. Its guidance was intended for all premises within the sector, not just 'residential care') and aided uniformity of approach. Its principles formed a sound platform which has reached into consequent guidance.

3.4.3. *Fire Precautions Act 1971*
The 1971 Act gathered all previous fire safety legislation under its umbrella. It imposed a regime of the 'fire certification' of premises. But the specialised housing and care home sector was not given a 'Designating Order' and hence was never brought within the certification process. The general powers within the Act did however apply and this gave a stronger enforcement capability to fire services over any premises felt to be in a dangerous state of use.

3.4.4. *Regulatory Reform (Fire Safety) Order 2005 (FSO)*
This subsumed the Fire Precautions Act and imposed a new regime based around the responsibility of building owners and/or managers to conduct regular fire risk assessments of their buildings and their mode of use and to have in place appropriate management, evacuation and maintenance plans for their premises. This duty applies to all 'Responsible Persons' across the sector.

3.4.5. *Care Acts*
The early part of the 21st century has seen the reform of the legislative regime covering the care sector with the Care Standards Act 2000 and the Care Home Regulations 2001. This has put into place clearly defined responsibilities and processes for care premises along with those under the RR(FS)O 2005 (see 3.5.1).

The Rose Park Care Home fire in Scotland in 2004, in which 14 residents died, was a catalytic event that illustrated the risks and gave extra force to a need for strong legislation and control systems. The inquiry found multiple physical defects and poor management practices that had contributed to the fire spread beyond its origin in a cupboard within a long, undivided communal corridor which gave open access on to too many resident's rooms.

3.4.6. *Grenfell Fire*
At present Government are recasting the whole building safety legislation landscape in the aftermath of this tragedy. Initially this is primarily giving a stringent emphasis on taller high-risk residential buildings. But much of generally lower rise buildings within the specialist housing and care homes sector could be viewed as of similar high risk, as highlighted within this research.

Also, of current influence are the building safety guides to building owners as required under the Regulatory Reform Order (Fire Safety) Order 2005 (FSO) and the associated guidance documents[15] which set out expectations on the assessment and risk remediation of existing buildings.

3.4.7. *Planning*
Planning has not traditionally been a conduit for fire safety requirements but of late the Greater London Authority (GLA) have begun to establish policies for disabled person evacuation in fire.

3.4.8. *Accessibility*
Building Regulations have been the vanguard of achieving widened accessibility to buildings. This has concurrently linked with fire safety in that inclusive ingress carries a heightened need for suitable escape measures for people with frailties.

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[14] *Home Office Fire and Emergency Planning Department, Draft guide to fire precautions in existing residential care premises (National British Standards, 1983)*

[15] *HM Government, Fire Safety Risk Assessment: Sleeping (The Stationery Office, 2006); HM Government, Fire Safety Risk Assessment: Residential Care Premises (Department for Communities and Local Government Publications, 2006)*

3.5. British Standards and other guidance sources

3.5.1. *Government Guides*
The 1983 Home Office 'Draft guide to fire precautions in existing residential care premises' was a major step for residential care. This was superseded by a series of 'fire risk' assessment guides issued in 2006 to provide guidance on complying with the Regulatory Reform (Fire Safety) Order 2005 (the Order). The volumes covering 'Sleeping Accommodation'; 'Residential Care Premises; and 'Means of Escape for Disabled People' are relevant to the assessment of existing premises in the sector.

3.5.2. *Health Technical Memoranda Fire Codes*
Experience gained from Hospitals and the development of HTM Fire Codes have been the source of useful guidance that has filtered down into design and management approaches used in the sector. Matters such as evacuation techniques, progressive horizontal layouts, the use of evacuation lifts are examples that have helped fire safety evolution in the sector. HTM84, which was adopted in Northern Ireland, provided particularly useful and thorough guidance for care home fire design prior to these being outlined within ADB.

3.5.3. *BS 9991[16] and BS 9999[17]*
The first specific guidance for specialised housing was included in BS 5588-1: 1986. Its recommendations followed principles of limiting travel distances both within a unit, and to a place of initial relative safety in common corridors. It also included control of furnished areas in common corridors, ease of staircase use, and pointed towards the consideration of evacuation lifts. This has been transferred into BS 9991 and the 2011 edition gave recommendations that include more emphasis on progressive horizontal evacuation principles. BS 9999 (first published in 2008) covers residential care homes and also offers general fire safety guidance that can be applied to all buildings.

BS 9991 updates are currently in the comment resolution stage and include further guidance on evacuation needs for residential buildings that now widely include for inclusive access.

3.5.4. *National Fire Chiefs Council Guidance*
'Fire Safety in Specialised Housing'[18] was published in 2017 and is a very comprehensive guide providing fire safety advice for specialised housing and supported housing, aimed at the assessment and management of existing premises, rather than new building design and construction. The guide offers practical advice on how to assess the risk from fire, appropriate fire prevention and protection measures and how to manage fire safety in such buildings. Distinction is made between the fire risk assessment for the building, which is a requirement of the Regulatory Reform Order (Fire Safety) Order 2005 (FSO), and person-centred fire risk assessments, outlining how the two should interface. In response to the anticipated vulnerability of residents, some of the principles advocated exceed the minimum standards outlined in ADB.

'Mobility Scooter Guidance for Residential Buildings'[19], published in 2018, provides guidance on the safe use, storage and charging of mobility scooters. The guide is aimed at those managing, advising or enforcing standards on residential buildings, as well as those who undertake fire risk assessment of such buildings.

3.5.5. *BRE Research/Guidance*
Across the years BRE have published many study papers of relevance to the sector in terms of general means of escape principles and design data for disabled people in fire and evacuation principles. 'Evacuating Vulnerable and Dependent People from Buildings in an Emergency'[20] provides particularly relevant guidance in relation to the issues which need to be considered when evacuating mobility impaired people.

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16 *BSI, BS9991:2015 Fire Safety in the design, management and use of residential buildings (BSI, 2015).*
17 *BSI, BS9999: 2020 Code of practice for fire safety in the design, management and use of buildings (BSI, 2020).*
18 *National Fire Chiefs Council, Fire Safety in Specialised Housing (NFCC, 2017).*
19 *National Fire Chiefs Council, Mobility Scooter Guidance for Residential Buildings (NFCC, 2018).*
20 *Crowder and Charters, FB 52 Evacuating Vulnerable and Dependent People from Buildings in an Emergency (BRE Trust, 2013).*

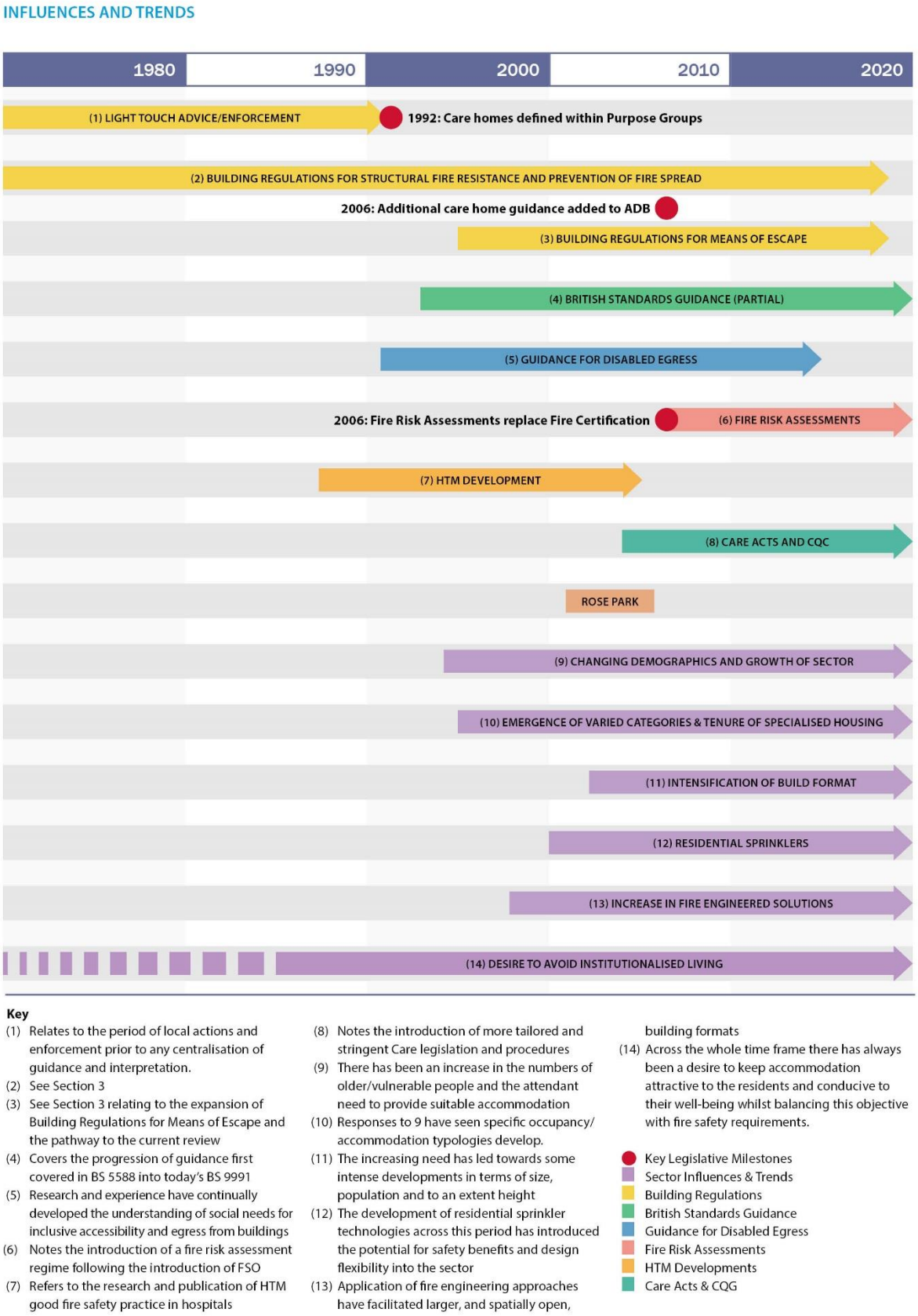

Figure 6: Legislative Timeline Set Against Sector Influences and Trends

4. Design and Construction

4.1. Outline Case Studies

4.1.1. A series of building case studies were collated via architectural practices working in the sector and members of the technical steering group. The case studies provided a range across each of the building typologies and were chosen in order to understand how the different design approaches could affect the overall fire strategy for the buildings. A total of 34 outline case studies, each located in England and already constructed and occupied, from 20 developer/client organisations were collected and examined. The buildings were designed by 6 different architectural practices and varied in terms of scale and tenure. Appendix 2 provides an overview of the case studies and the analysis undertaken.

4.1.2. In reviewing the outline case studies, it was observed that half of the building designs varied from Approved Document B (ADB) guidance and required either partial or full fire engineered solutions. Understanding the reasons behind these deviations was considered important as these implied a potential shortfall in ADB due to the limited guidance for these building typologies. A fire engineered solution would prove that a design is of equivalent safety, implying that the shortfall within ADB is with regards to the flexibility in application for these particular building typologies.

4.1.3. It was noted that there was no correlation between the tenure of the buildings and the deviation from ADB. There was however, some correlation between the different typologies and their route to compliance with ADB, as outlined below;

- Retirement housing and housing with care (typologies 1 & 2) either adhered fully to or partially varied from ADB guidance. The reasons for deviation, although not typology specific, were primarily due to design features, such as extended travel distances (to increase efficiency of the layout), the inclusion of atria (to improve light and ventilation in corridors, as well as social connection and wayfinding) or deck access (to create dual aspect apartments and improve ventilation). The additional measures such as fire engineered solutions and the application of BS9991 do address the specific typologies and make appropriate recommendations, beyond that outlined within ADB.
- Supported housing types 1 & 2 (typologies 3 & 4) in the main adhered with ADB guidance.
- A significant number of the more recently constructed care homes (typology 5), i.e. those completed since 2015, tended to utilised more fire engineered solutions.

4.1.4. Compared to the other typologies, the supported housing buildings (typologies 3 & 4) had a lower number of units, making them simpler in design terms to achieve compliance with ADB guidance.

4.1.5. Care homes (typology 5) often had extended travel distances from the bedrooms to the nearest escape stair, requiring fire engineered solutions and/or the inclusion of sprinklers. Recently constructed care homes had increased in scale in recent years, resulting in larger clusters of bedrooms being served by stairs. This approach appears to have been utilised to achieve an efficient layout, potentially eliminating the cost of providing additional stairs and to keep the lengths of corridors to a minimum for residents on a daily basis.

4.2. Scale of Development

4.2.1. In order to improve cost efficiencies in relation to management, catering and care delivery, care homes (typology 5) and housing with care schemes (typology 2) have increased in size over the past decade.

4.2.2. The average number of dwellings of private housing with care developments has increased by 39% in the last decade, from 41 units between 2000 and 2009 to 57 between 2010 and 2019 [21]. The range of facilities within retirement housing and housing with care developments varies and is invariably dependant on tenure and size of developments. Larger retirement villages, which rely on attractive lifestyle offers to attract and retain residents, often include gyms, health,

21 Harwood, Rising investment to underpin increase in development of seniors housing (Knight Frank, 2020).

therapy and leisure facilities as well as extensive restaurants and bars. Facilities within the affordable sector are less extensive.

4.2.3. In our experience over the past 25 years within this sector, the size of retirement housing and housing with care developments (typologies 1 & 2) is continuing to increase with the majority of developers seeking to achieve over 100 dwellings to ensure ongoing viability. Sites in urban locations, often with retail and integrated communal facilities on the ground floor, are much sought after, which in turn is likely to increase the storey heights and density of these typologies.

4.2.4. The average size of care homes being built in 2020 in England is between 60-80 beds[22]. As residents of care homes have higher care needs, and are no longer living independently, the length of stay is lower than the other typologies resulting in a greater 'churn' rate. Operators therefore need to balance the acceptable vacancy levels against operational efficiencies. For these reasons the size of the care home developments being developed is unlikely to increase beyond 100 bedrooms, which reflects our experience in this market.

4.2.5. The size of developments for supported housing have tended to remain constant in order to maintain a sense of home which is non-institutional. Supported housing type 1 buildings tend to comprise 8-12 apartments, whilst supported housing type 2 buildings tend to have circa 6-8 bedrooms within a shared dwelling.

4.3. Technology

4.3.1. Assistive technology (AT) devices, such as vibrating pillows or flashing beacons, when utilised, could be of assistance for some residents with hearing or visual impairments when the fire alarm is activated. AT devices connected to the fire alarm system will alert residents in the event of a fire, reducing their reliance on a management response to be alerted of the fire. AT devices are not currently described within ADB guidance although they are referred to other associated documents such as BS5839-6 2020[23]. From the interviews it was evident that the use of AT devices was based on the assessment of individual's needs, although their effectiveness in practice was not specifically commented on.

4.3.2. Some people with physical mobility impairments will require assistance to evacuate across each of the typologies. As an example, free swing door closers, which are installed to enable residents to easily use their front doors on a daily basis, will be released in the event of a fire resulting in some residents being unable to exit their dwelling due to the increased weight of the door.

4.3.3. Those residents with dementia, mental health issues and learning disabilities are likely to require staff assistance as technological devices, as well as fire alarm soundings, can often cause them to become confused. Smoke detectors within kitchens linked to the assistive technology call system, rather than the alarm system, have however been found to be beneficial in practice for these particular resident groups. This approach alerts staff in the event that, for example, a resident has inadvertently burnt food, allowing early intervention to avoid the escalation of a fire incident. ADB Vol 1 B1 paragraphs 1.12 and 1.13 sheltered housing states that the detection systems in flats should connect to a central monitoring point or alarm receiving centre. The system should alert the warden or supervisor and identify the individual flat where detected to alert staff to investigate.

22 *Bhogal, Healthcare Development Opportunities Research 2020 (Knight Frank, 2020)*

23 *BSI, BS5839-6: 2019+A1:2020. Fire detection and fire alarm systems for buildings - Code of practice for the design, installation, commissioning and maintenance of fire detection and fire alarm systems in domestic premises (BSI, 2020)*

4.4. Mobility Scooters

Mobility scooters are classified into three categories under the Use of Invalid Carriages on the Highways Regulations 1988 as indicated in
4.4.1. Table 2: Classification of Mobility Scooters below.

Table 2: Classification of Mobility Scooters

Class	Description
1	Manual wheelchairs that are not electrically propelled
2	Powered wheelchairs and scooters intended for use on footpaths
3	Powered scooters and invalid carriages intended for use on the road

4.4.2. Mobility scooters are often used by mobility-impaired occupants within retirement housing and housing with care models (typologies 1 & 2), where older residents live more independently compared to care homes (typology 5). Occupants of care homes are less likely to go outside independently, resulting in occupants with mobility issues being more likely to use wheelchairs which can be controlled by another person. For the supported housing typologies, the use of mobility scooters will be dependent on the individual requirements of occupants which varies greatly. Although the use of mobility scooters and electric wheelchairs have various benefits for mobility-impaired persons, there are fire safety concerns with their storage and charging. For instance, batteries (especially lithium-ion) used in mobility scooters are a potential fire risk especially when charging, and in the event of a fire can also release toxic fumes and hydrogen [24].

4.4.3. Whilst there are relatively few recorded instances of fires being caused by mobility scooters, mobility scooters in fire situations can release large volumes of toxic smoke and generate significant heat outputs. Experiments carried out by the Building Research Establishment (BRE), see Figure 7, demonstrated the ease with which a mobility scooter fire in a corridor could spread to nearby scooters, due to exponentially increased heat rates, along with the toxicity of the smoke released[25].

24 National Fire Chiefs Council, Mobility Scooter Guidance for Residential Buildings (NFFC, 2018)
25 BRE Group, BRE Trust Project: Heat release and smoke production from burning mobility scooters (BRE, 2015)

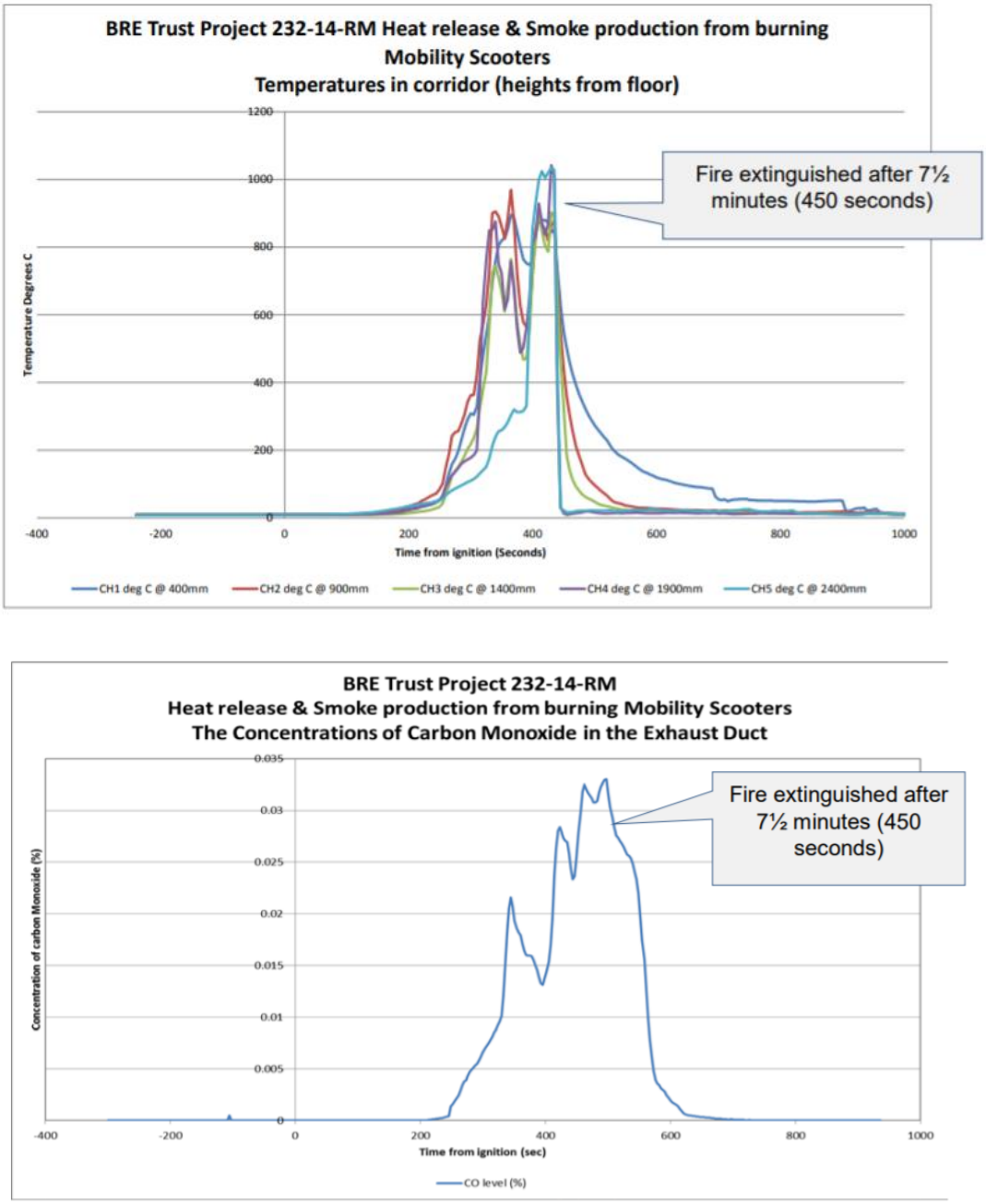

Figure 7: Findings from BRE Experiment into Mobility Scooters

4.4.4. Considering the size and speed of mobility scooters, manoeuvrability within the building and fire risk issues associated with the storage of these, it follows that their use needs to be carefully considered at the design stage. In modern developments storage of mobility scooters within circulation areas or within dwellings is not considered to be acceptable best practice. It was noted within the case studies examined, dedicated mobility scooter stores were provided to all of the developments for typologies 1 & 2, with the exception of one private retirement village in a rural location (Appendix 3). This approach is supported from the data obtained through the survey, as indicated in Figure 8 below.

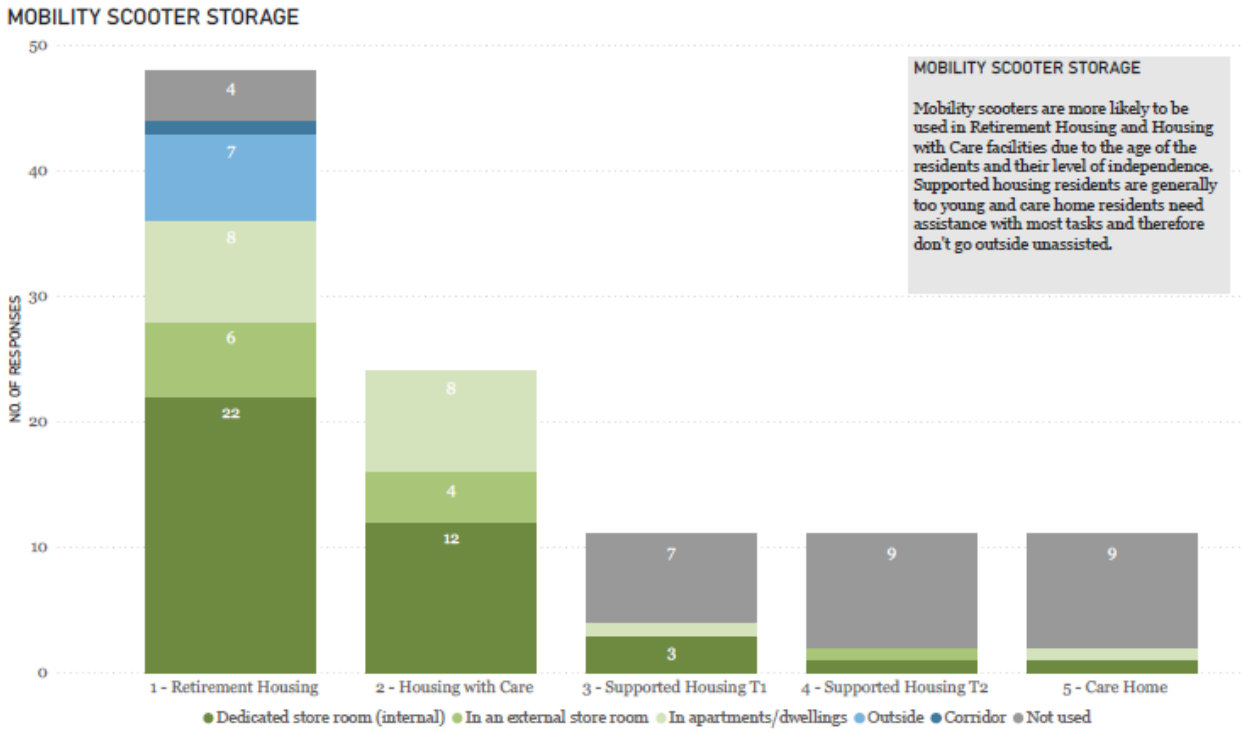

Figure 8: Storage of Mobility Scooters: Appendix 1 Quantitative Analysis, Page 125

4.4.5. The report 'Mobility Scooter Guidance for Residential Buildings' by the NFCC[26] provides good practice and considerations for the storage and internal use of electric mobility scooters. The guidance highlights the importance of ensuring the place of storage is enclosed in appropriate fire-resisting construction (30 minutes for up to 3 scooters or 60 minutes for more) with a suitable fire detection system. Importantly escape routes should be kept clear of mobility scooters at all times to enable residents to evacuate quickly and safely.

4.4.6. Whilst BS9991[27] provides limited advice on the storage and charging for mobility scooters, it does not differentiate between these and electric wheelchairs. ADB does not provide any guidance on the use, charging and storage of mobility scooters within buildings.

4.4.7. Research carried out by BRE Trust[28] into fires involving mobility scooters explored the effectiveness of sprinklers in suppressing such fires, compared to manually extinguishing the fire. From the experiments carried out it was clearly demonstrated that a sprinkler system was able to effectively suppress the fire before the fire reached a critical stage (see figure 9). The report highlighted a need to undertake further work to examine a range of types of scooters, suppression types and room dimensions to understand the most effective solution to storage.

26 *National Fire Chiefs Council, Mobility Scooter Guidance for Residential Buildings (NFFC, 2018).*
27 *BSI, Fire safety in the design, management and use of residential buildings – Code of practice (BSI, 2011).*
28 *Koo, Fire Experiments on mobility scooters protected by sprinklers (BRE Global, 2016).*

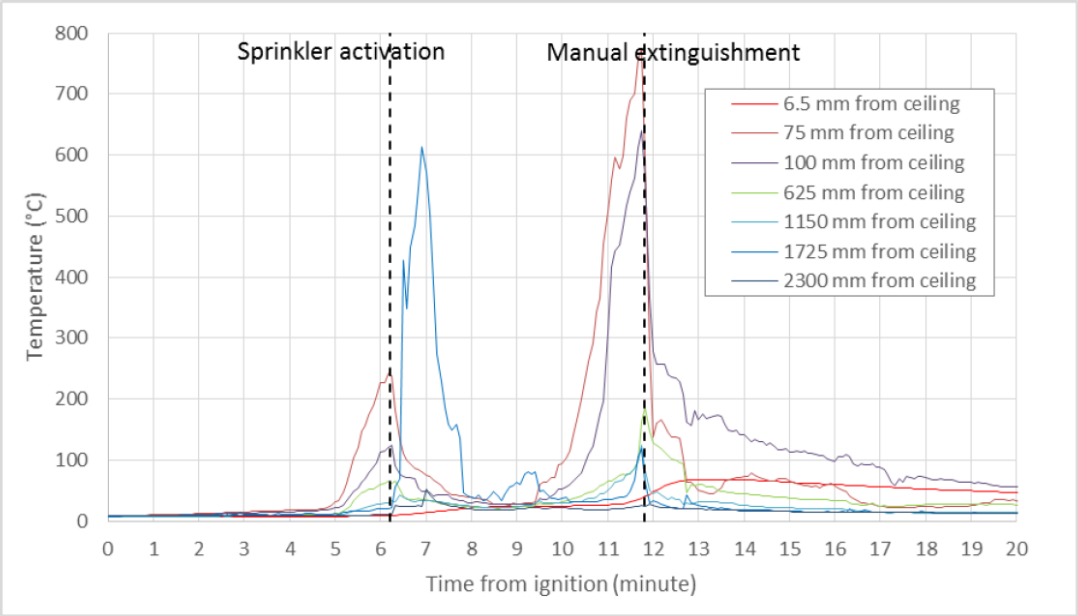

Figure 9: Temperature data from BRE experiment relating to sprinkler response to the ignition of a mobility scooter

4.5. Purpose Groups

4.5.1. Under the Building Regulations typologies 4 and 5, as defined within this report, are considered to fall within Purpose Group 2(a) Residential Institutional. ABD makes specific recommendations for Residential Institutional building types which reflect the needs of those residents and the management regime within the building. It is, however, noted that since the inclusion of means of escape measures relating to care homes within ADB in 1992 and the reference to sprinklers in 2006, the scale of the buildings has increased in size.

4.5.2. Typologies 1, 2 and 3 are currently covered under Purpose Group 1 Residential Dwellings, with limited differentiation in ADB between the needs of these particular residents compared to those in general needs housing. The limited differentiation made within ADB is in reference to sheltered housing (typology 1) for portions of ADB creates a hybrid scenario between parts of the regulations but ABD is silent on typologies 2 and 3 leaving these more open to interpretation, causing inconsistencies across the sector.

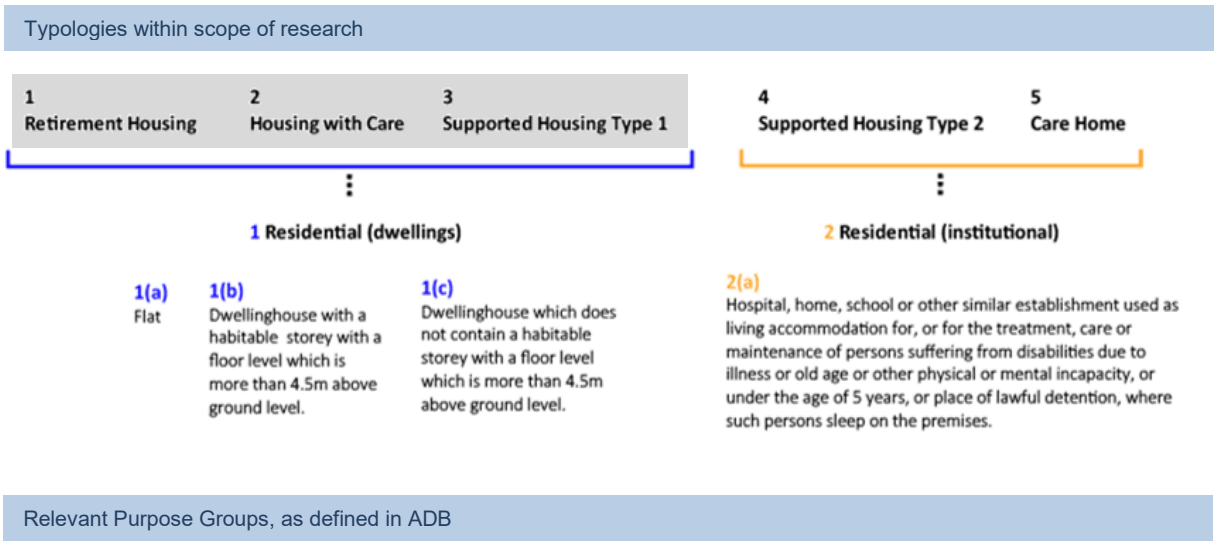

Figure 10: Shortfall ('grey area') in Purpose Groups as defined in Table D1 of ADB, mapped against typologies defined

4.5.3. A review of the Scottish Technical Handbook and associated government guidance[29] highlighted an in-depth approach to differentiating the particular requirements of the buildings within this 'grey' area (see Figure 10), which much of today's specialised housing falls into. Whilst the NFCC[30] guidance provides a similar framework for England; this guidance is not adopted by government. A summary of these guidance documents is outlined in section 6 of this report.

4.6. Evacuation Strategy for Housing (typologies 1, 2 and 3)

4.6.1. The specialised housing typologies within the scope of this report (typologies 1, 2 and 3) tend to follow that of ADB Purpose Group 1 for general needs dwellings, utilising a 'stay put' policy with the recommended compartmentation guidelines. For typologies 1 and 2, an acceptance is often made by designers for a level of partial evacuation should this be required with cross-corridor compartmentation and sectional alarm systems. Such cross-corridor doors are generally placed in addition to the door required to divide a corridor with escape at each end. BS9991 sets this out;

> *"Where occupants are not capable of independent evacuation from their flat without external assistance, the protected stairway enclosures and protected corridor layouts, incorporating fire subdivisions as necessary, should be planned and constructed such that no person would have to travel more than 7.5 m from the flat entrance door along a corridor or lobby before reaching a fire door accessing either a protected stairway enclosure or another protected corridor zone".*

4.6.2. Interviews with operators of the typologies 1 & 2 buildings also confirmed that this approach is sometimes taken in practice with occupants in the apartments adjacent to the source of a fire being evacuated into the adjacent corridor compartment, rather than staying put. It is however noted that, under ADB guidance for apartments, corridor ventilation has not been designed to deal with this approach. Additionally, with no safe place of refuge away from the corridor, those evacuated could obstruct the route needed for effective firefighting.

4.6.3. Refuge points within stair cores, although suggested within BS9991 are not a requirement under Approved Document B for the specialised housing typologies (typologies 1, 2 and 3). They are, however, often provided at the request of the Building Control body, although advice on this can vary across England. Where refuges are provided one refuge space tends to be provided in each stair core at each level, as is described in Part B vol 2 section 3. Typically, where the official strategy was stay put these 'refuges' were spaces allowing for potential refuge but not provided with communication or fire alarm linkage required where formally part of the strategy. BS9991 states:

> *"For all specialized housing accommodation types, when deciding on the dimensions of protected stairways and corridor zones, provision should be made for adequate refuge space".*

4.6.4. In the absence of specific ADB guidance for specialised housing, many Building Control bodies see this type of housing as a hybrid between Purpose Groups 1 and 2(a). Within the case studies for these typologies the majority had a space for refuge points allowed for on the upper floors, although from experience not all systems installed have the ability to allow residents to call for assistance if required.

4.6.5. It was notable from the respondents to the survey questionnaire that few buildings within these typologies had fire evacuation lifts and the majority did not have sprinklers installed.

4.7. Evacuation Strategy for Residential Institutional (typologies 4 and 5)

4.7.1. Approved Document B includes guidance for progressive horizontal evacuation in care homes (typology 5), categorised as Purpose Group 2(a), which could include supported housing type

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29 Scottish Government, Practical Fire Safety Guidance for existing Specialised Housing and similar premises (The Scottish Government, 2020).

30 National Fire Chiefs Council, Fire Safety in Specialised Housing (NFFC, 2017).

2 (typology 4). Within this approach residents move horizontally through the building, managed by the staff, to reach a place of relative safety (i.e. into another compartment or a place of refuge) within the building.

4.7.2. Whilst ADB provides indicative guidance to horizontal evacuation, it does state that the fire safety strategy needs to take into consideration "the way a building is designed, furnished, staffed and managed, and the level of dependency of residents"[31]. Adherence to the guidance does not therefore ensure full compliance, although in practice it is often interpreted as such.

4.7.3. For residential institutional buildings, ADB sets out a maximum travel distance within each protected area (sub compartment) of 9m in a single direction and 18m where more than one direction is available, with a maximum of 64m from any point to a storey exit or final exit.

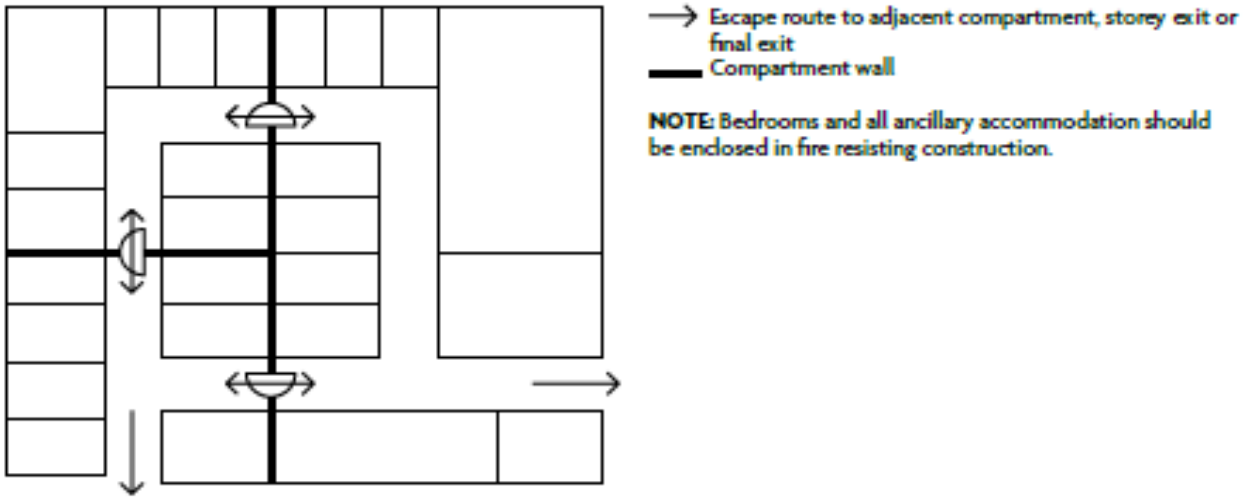

Figure 11: Progressive Horizontal Evacuation in Care Homes, Diagram 2.11, ADB

4.7.4. Furthermore diagram 2.11 within ADB (figure 11 above) sets out the basic principle for the provision of two available choices of adjacent compartments to evacuate to. However, it is not clear on:

a) Demonstrating in a clear way the limit of single direction of escape where a bedroom is in a dead-end condition, resulting in such extended dead-end bedrooms require fire engineering solutions. It is noted that older guidance documents, such as the Northern Ireland HTM89, were clear on this and provided more explanatory diagrams. From our experience designers often misunderstand the 9m/18m restriction resulting in the need for fire engineering.
b) The acceptability of the stair as protected area. The diagram assumes a 'loop' arrangement and so doesn't cover whether a stair at the end of a wing provides one of the minimum of two protected areas. Para 2.4 makes it clear what is expected in principle.

4.7.5. There is no specific mention in ADB of requirements for care home stairs to accommodate anticipated vertical evacuation methods. In practice these would require the use of evacuation lifts or carry-down procedures.

4.7.6. Where sprinklers are not installed, ADB also limits the number of bedrooms within one sub-compartment or protected area to 10 bedrooms. How bedrooms could be arranged within the protected area is not defined within ADB, although the limit on travel distances within a compartment is defined. Whilst these limitations are useful, there is no method described on how to determine the actual number of bedrooms within a protected area, based on the predicted staffing levels and resident needs.

31 *Building Regulations, Approved Document B Part B Volume 1 (HM Government, 2010).*

4.7.7. Fire Safety Risk Assessment, Residential Care Premise (DCLG)[32], the guidance under the Regulatory Reform Order [33] provides useful advice, beyond ADB, on the approach to managing evacuation of residents of care homes in practice. It includes useful detailed diagrams of escape routes, guidance on building layouts and introduces the concept of varying levels of risk. The FSO highlights the following as factors which should be considered;

- type, number and dependency of people using the premises
- assisted means of escape
- evacuation strategy
- escape time and travel distance
- age and construction of the premises
- the number of escape routes and exits
- the management of escape routes; and
- emergency evacuation of persons with mobility impairments

4.7.8. The guide states clearly that in practice the aim should be to evacuate all occupants from a protected area (sub compartment) within 2 ½ minutes from the alarm being raised. Research from BRE Trust[34] does however put the 2 ½ minute evacuation time in question, recognising that it is unlikely to be achievable given the mobility status of many residents and number of staff available, particularly on night shifts.

4.7.9. It is clear that to achieve this evacuation time, staff numbers and the needs of the residents in a protected area are interrelated. However, ADB gives no guidance on how to address such factors, beyond stating a maximum of 10 beds. The ability to evacuate 10 beds in a sub compartment within 2 ½ minutes for those with varying needs should be reviewed further.

4.8. Sprinklers

4.8.1. In Scotland there has been a requirement to install fire sprinkler systems in all new care homes and sheltered housing since 2005, which would apply to all the specialised housing and care home typologies being considered in this report. The same requirement was introduced by the Welsh Government in January 2016. The Scottish Government introduced the requirement in part due to its response to the Rosepark Care Home fire of 2004, in which 14 residents died. The Rose Park inquiry found that too many residents lived off one open corridor and one response to this risk would have been the installation of a sprinkler system. The Fire Sprinklers in Residential Premises (Scotland) Bill 2003 stated that the Scottish Fire Service believes that sprinklers will not only reduce injuries to residents in a fire situation but also to members of the Fire Service too. BS9991 requires sprinklers to be installed in the apartments and common areas (except corridors and staircases) of buildings where residents are not capable of independent evacuation, one such building type is a care home.

4.8.2. Sprinklers are required in new care homes in Australia, the USA and also in Hong Kong. In Hong Kong the requirement applies to buildings over 230m^2 in area, which is akin to the size of a large house, such as those used for supported housing type 2 (typology 4).

4.8.3. The BRE report 'BD 2887; Work Stream 5: Sprinkler Provisions' of 2015[35] used for its analysis 76% +- 8% as the number of deaths that would be saved by sprinklers. The costs of the sprinkler installation, water supply and annual inspection and maintenance were analysed against the benefits of lives saved, injuries prevented and property loss savings. The cost benefit analysis concluded that sprinklers are probably cost effective in residential care homes (typology 5). As specialised housing models (typologies 1,2 & 3) were not separately defined against other forms of general needs housing, the use of sprinklers was inconclusive for these typologies as a subset.

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32 HM Government, Fire Safety Risk Assessment, residential care premises (HM Government, 2006)

33 The Regulatory Reform (Fire Safety) Order 2005 (HM Government, 2005).

34 Crowder and Charters, FB 52 Evacuating Vulnerable and Dependent People from Buildings in an Emergency (BRE Trust, 2013).

35 BRE Group, Compartment sizes, resistance to fire and fire safety project, Work stream 5 – Sprinkler provisions, BD2887 (BRE Trust, 2015)

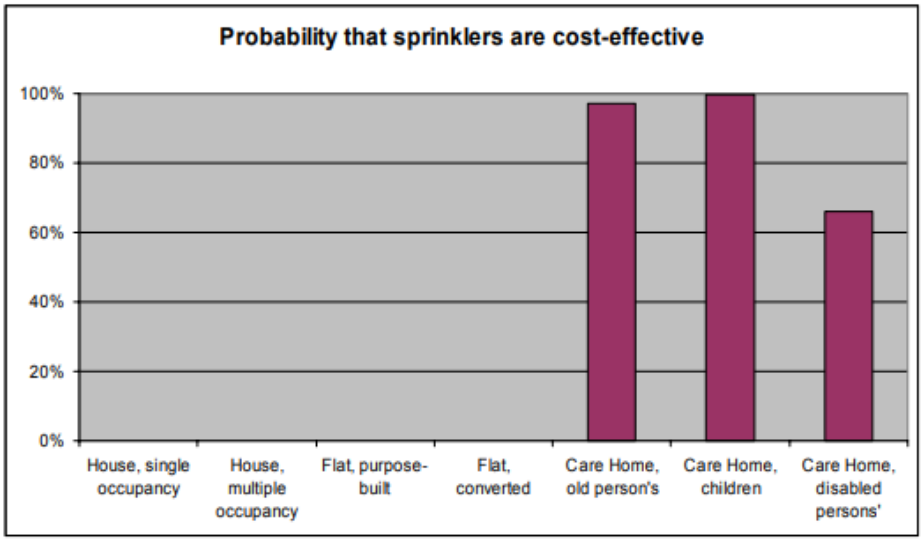

Figure 6.2 Probability that sprinklers will be cost-effective

6.9 Cost benefit calculations for 'high-risk' dwellings

From section 6.8, it appears that residential sprinklers may be cost-effective in care homes, but not in other types of property. However, the other categories are all quite broad in definition, and may contain a subset of high-risk properties whose effect on the cost-benefit ratio is not apparent when the ratio is calculated for the category as a whole.

Figure 12: Extract from the BRE report that shows sprinklers in care homes are likely to be 97% cost effective

4.8.4. The impact assessment that was produced by the Welsh Government in 2013[36] to assess the proposal to include sprinklers in new residential buildings concluded that sprinklers are cost effective in new care homes and halls/dormitories. This is mainly due to the reduction in financial losses from damage to the building, its contents and business interruption.

4.8.5. Resident delays in fire evacuation due to mobility impairments are expected and recognised in a number of research projects and fire incident reports. NFCC[37] and Scottish guidance[38] recommends the use of sprinkler systems to aid evacuation.

4.8.6. Ove Arup & Partners undertook research for the British Automatic Fire Sprinkler Association and then produced a report called Sprinklers for Safer Living: The Benefits of Automatic Fire Suppression Systems in Residential Care Premises 2010[39]. The report recognises the benefit of compartmentation, as outlined in ADB, in preventing fire spread beyond the compartment of fire origin but highlighted that a number of fires do still spread within the fire compartment, beyond the room of origin. This was considered to be due to either the severity of the fire or breakdown of the passive fire protection (in particular the non-functioning of the self-closing fire doors).

36 *BRE Fire and Security, Cost benefit analysis of residential sprinklers for Wales (BRE Global, 2013).*
37 *National Fire Chiefs Council, Fire Safety in Specialised Housing (NFFC, 2017).*
38 *Scottish Government, Practical Fire Safety Guidance for existing Specialised Housing and similar premises (The Scottish Government, 2020).*
39 *ArupFire, Sprinklers for Safer Living: The Benefits of Automatic Fire Suppression Systems in Residential Care Premise (BAFSA, 2010).*

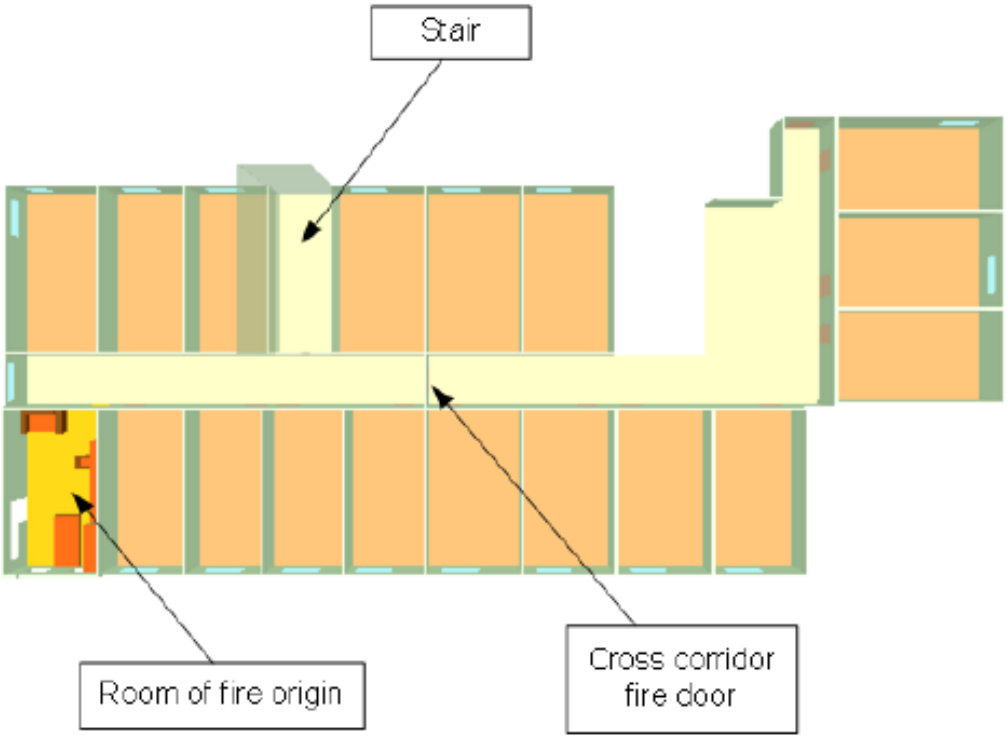

Figure 13: Extract from the Arup fire and smoke study – showing general layout of the model used

4.8.7. Arup undertook a fire and smoke study as part of the research (Figure 13 - Figure 15) which found that where a sprinkler system was installed in a care home (typology 5), it lowered temperatures in communal corridors and rooms in the locality of the room where the fire started to within life tenable levels. Furthermore, levels of visibility were tenable in adjacent rooms within the fire compartment as well as in those in adjacent compartments. Conditions were found to be significantly worse in nearby bedrooms and the communal corridor when sprinklers were not included in the study.

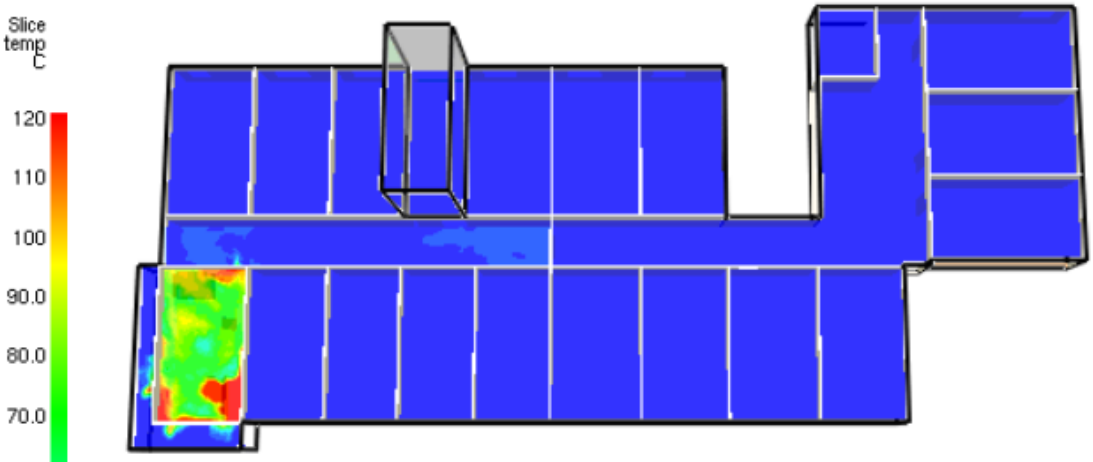

Figure 6: Temperature profile at 10 minutes – sprinklered

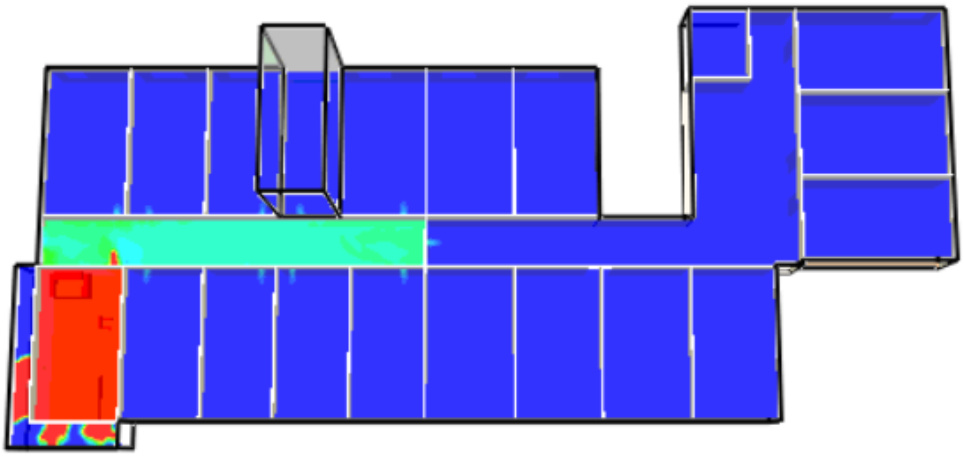

Figure 7: Temperature profile at 10 minutes – unsprinklered

Figure 14: Images from the Arup fire and smoke study – showing temperature profiles in sprinklered and unsprinklered buildings

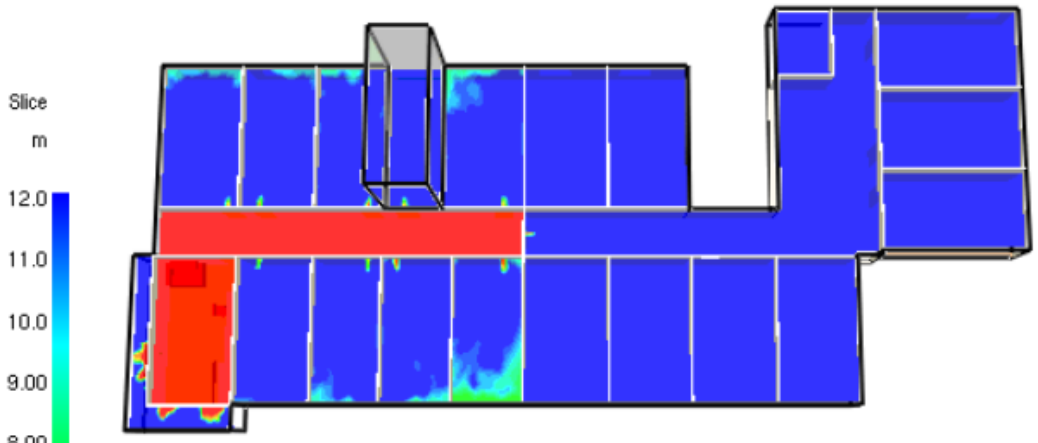

Figure 8: Visibility profile at 10 minutes – sprinklered

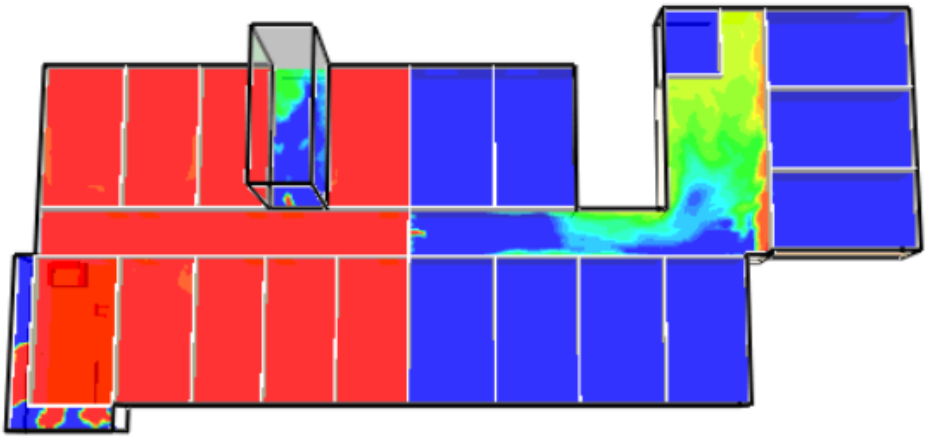

Figure 9: Visibility profile at 10 minutes – unsprinklered

Figure 15: Images from the Arup fire and smoke study – showing visibility profiles in sprinklered and unsprinklered buildings

4.8.8. The study therefore concluded that, although sprinklers were unlikely to prevent injury or fatality of the occupant in the bed during a bed fire, they were effective in the control of a fire, whilst providing improved visibility conditions to the residents of the building, particularly beyond the room of origin. It also concluded that where residents require assistance it is likely that the evacuation process will take longer and sprinklers provide significant benefits to address this risk.

4.8.9. Our direct experience of the sector is that, since the introduction of the BS 9251[40] in 2014, the majority of care homes are being constructed with sprinkler systems. Within the specialised housing developments, typologies 1 and 2, sprinklers are becoming more common as the scale of these developments increase.

40 BSI, BS 9251:2021 – TC: Fire sprinkler systems for domestic and residential occupancies. Code of practice. (BSI, 2021)

4.9. Forms of Construction

4.9.1. From our experience over the past 25 years in this sector, the construction of specialised housing and care homes still remains primarily traditional masonry structure with concrete floors for the majority of building typologies. On the larger scale developments, concrete framed structures are used for buildings over 4 storeys.

4.9.2. Timber frame has been used in the sector primarily, although not exclusively, for care homes which are often 2-3 storeys with simple structure and plan layout which stack vertically.

4.9.3. Steel frame and light gauge steel has become more common in recent years as a way of increasing the speed of construction and reducing cost. However, due to the complexity of ensuring protection of the elements of structure, steel still remains relatively uncommon in this sector.

4.9.4. Modular construction, where it is used, tends to relate to bathroom pods rather than complete dwellings or bedrooms. Even the use of pods is rare due to a lack of economy of scale. Of the case studies examined, only one, a large care home over 18 metres in height, had utilised bathroom pods. This use of modular construction is however set to change as the developments become larger in scale and as a consequence of new developers entering the sector.

4.9.5. As the forms of construction utilised do not differ greatly from those used on other residential buildings, issues around the rate of fire spread in these buildings would be similar to those in general needs housing.

4.10. External Fire Spread

4.10.1. As a result of failings in the construction industry, the ban on combustible materials was introduced in 2018[41] to address fire spread on high rise facades and to reflect the difficulty in fighting fires at height. The present trigger height of 18m only captures a small segment of the care home and specialised housing sector's buildings. Even if it was lowered to 11m, as considered in the recent government consultation, it would still not include the majority of new buildings in the specialised housing and care home sector as our research and experience has shown they are primarily lower rise (under 4 storeys in height).

4.10.2. No evidence has been found to suggest that external facade fires are any more frequent in the sector being considered or that the occupants of the buildings influence the source of such fires any more than general needs housing. The evidence does show that many residents of specialised housing and care homes will have extended escape times due to their age, mobility and other impairments, and that their behaviour may also be affected in a fire situation. Consequently, a rapidly spreading external façade fire, which breaches the external envelope or causes smoke ingress into the building, is very likely to hinder escape for residents who have extended escape times.

4.10.3. It was noted that a number of the developer and client organisations interviewed have made a conscious decision to apply a ban on combustible materials within the façades of buildings across the sector building typologies of any height. This is due to a recognition of the vulnerable nature of the residents and the time required to evacuate a building, as well as issues related to building insurance.

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41 Building Regulations, The Building (Amendment) Regulations 2018 (HM Government, 2018).

5. Occupation and Operation

5.1 Of the 34 case studies, 11 were chosen to be detailed case studies. The survey questionnaires were completed by the building managers for these 11 care home buildings and a detailed technical one to one interview was then also carried out with the person within the management organisation responsible for fire safety.

5.2. Specialised housing and care homes are highly functional buildings and their designs are inherently linked to how the buildings are subsequently managed. The interviews therefore sought to understand if there were any disconnects between management expectations under ADB guidance and the reality of how the buildings were subsequently managed. During this process, some themes have emerged which are set out below.

5.3. Design Considerations

5.3.1. From our extensive sector experience there are a number of design details which are considered to be good practice to create an enabling/inclusive environment for residents, aiding daily living, which also have a positive impact on a resident's ability to self-evacuate. These typically include:

a) Level access to all thresholds
b) A choice of ramp and stairs options where a change in level is unavoidable
c) Appropriate ironmongery suitable for those with manual dexterity issues to enable ease of door operation
d) Wayfinding through a logical, non-repetitive building layout, which assists people with cognitive impairments
e) Open plan dwellings which reduce the number of physical and visual barriers within the dwelling
f) Assistive technology devices for people with visual and/or hearing impairments, which trigger in the event of a fire alarm activation
g) Generous circulation with wide corridors and electromagnetic hold open to cross corridor doors.

5.3.2. Approved Document M4 (Categories 2 & 3) Volume 1 for dwellings are normally applied to the specialised housing typologies for increased accessibility. Whilst this is not specifically a requirement under the Approved Documents, it is considered good practice by designers and is often applied through the Local Planning Authority.

5.3.3. It was notable from the survey response (see Figure 16) that the non-provision of many of these items still remains a barrier to self-evacuation for residents, despite some of them being a requirement for housing under Approved Document M4 (Categories 2 & 3) Volume 1 for dwellings (items a-c above).

5.3.4. As an example, level thresholds can exceed the minimum requirement of no more than 15mm upstand due to either incorrect installation, a difference in floor finishes or movement within a building after completion, creating a potential barrier or trip hazard for residents, especially during an escape situation. Buildings surveyed often did not include these features where they predate ADM or best practice has been not adhered to as it is not a regulatory requirement.

5.3.5. Conversely, whilst free swing door closers make doors easy to use on a daily basis, they can make front doors to individual dwellings too heavy for some residents to open when activated. Free swing door closers are linked to the fire alarm system and revert to a normal door closer when the alarm is activated. This would be especially problematic for those attempting to escape from the flat of origin of the fire.

5.3.6. Open plan dwellings greatly assist those with cognitive and mobility issues by removing the physical and visual barrier of doors within the living space. This approach not only creates an enabling environment on a daily basis for the occupant but also assists greatly when escaping in the event of a fire. However, due to concerns about the speed of egress for the residents in

specialist housing, BS9991[42] suggests that open plan dwellings should not be provided for accommodation 'where occupants are not capable of independent evacuation'.

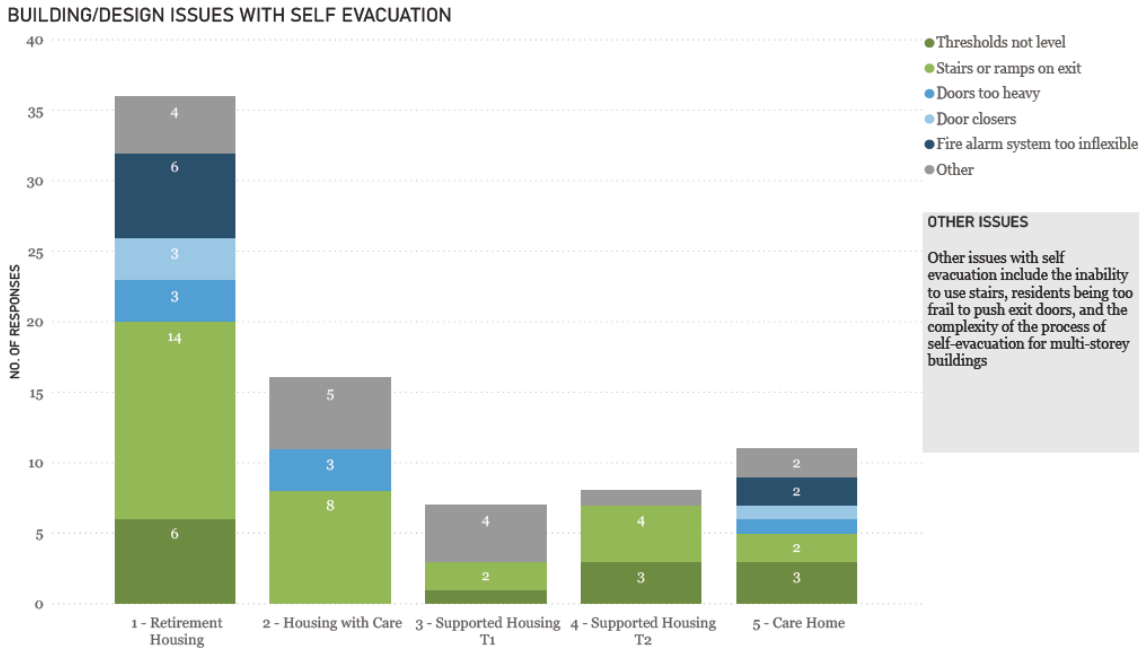

Figure 16: Building Design Issues Which Impede Self-evacuation: Appendix 1 Quantitative Analysis Page 125

5.4. Evacuation

5.4.1. Longer evacuation times are expected in specialised housing and care homes compared to other residential buildings as we have stated earlier in this report.

5.4.2. For dwellings (typologies 1,2 & 3), 'stay put' evacuation policies are normally applied with an assumption that assistance will be provided, for the those who require it, if evacuation is required in an emergency scenario. It is apparent from the detailed interviews undertaken that whilst stay put evacuation strategies are employed for these typologies, there is also a practice by some operators of evacuating those in adjacent dwellings to where the fire alarm activation has occurred. This practice is a partial phased evacuation; a hybrid between the stay put approach for Purpose Group 1 Residential Dwellings and horizontal evacuation, normally applied to Purpose Group 2 Residential Institutional. This approach is reliant on the availability of staff to assist the residents who are unable to self-evacuate. The alarm system notifies staff via a mobile handset that an alarm has activated in a particular apartment, allowing them to then investigate and assist as necessary. Within the case studies there were examples of such assistance not being available at night, particularly within typology 1, due to a lack of staff resulting in the managers relying on upon the fire and rescue service to assist in the event of a rescue scenario. Where a resident is less likely to be able to self-evacuate this would be highlighted within the personal emergency evacuation plans stored near the buildings entrance for fire brigade use.

42 *BSI, BS9991: 2015 Fire Safety in the design, management and use of residential buildings (BSI, 2015).*

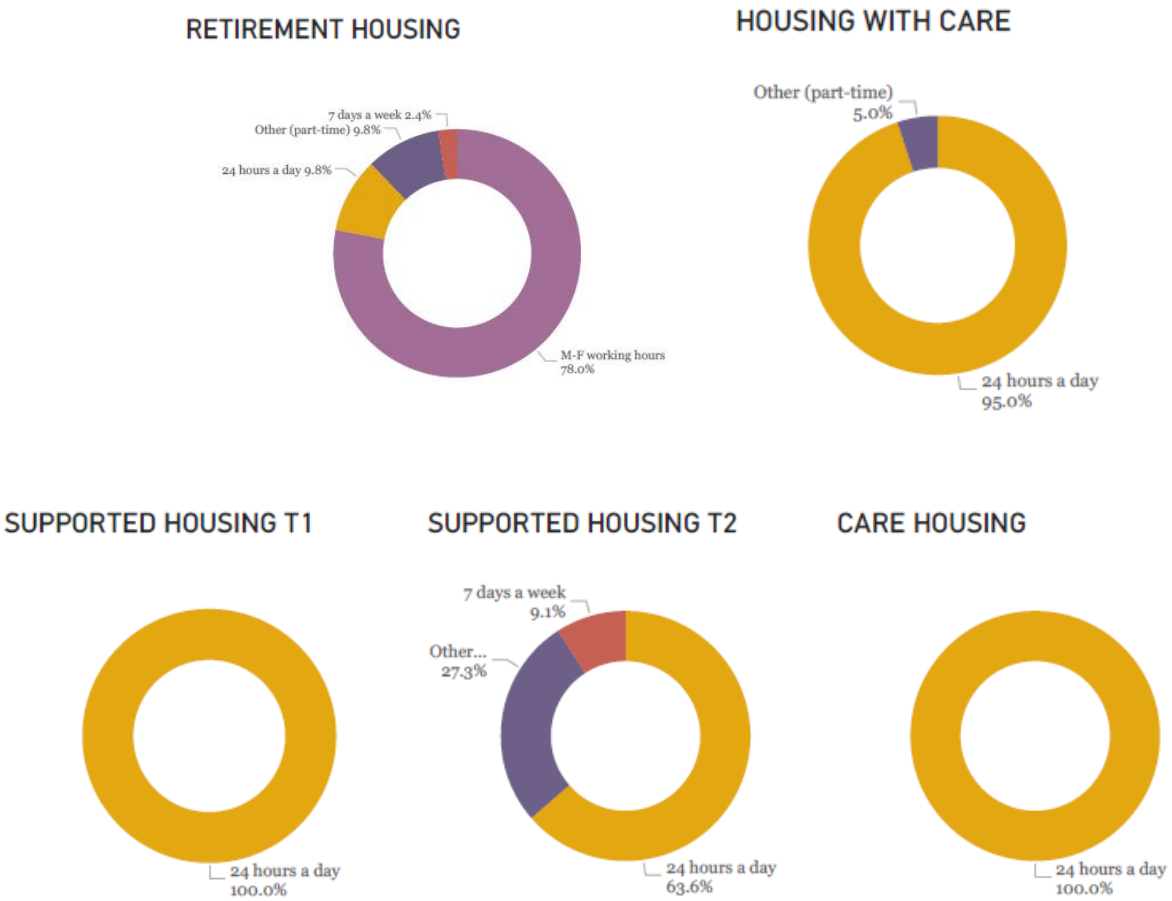

Figure 17: Levels of staffing per typology: Appendix 1 Quantitative Analysis Page 128

5.4.3. As indicated in Figure 17, retirement living buildings, where there is an expectation that residents are more physically able, do not have staff on site across a 24-hour period to assist with evacuation, should this be required, increasing the reliance on the Fire and Rescue Service.

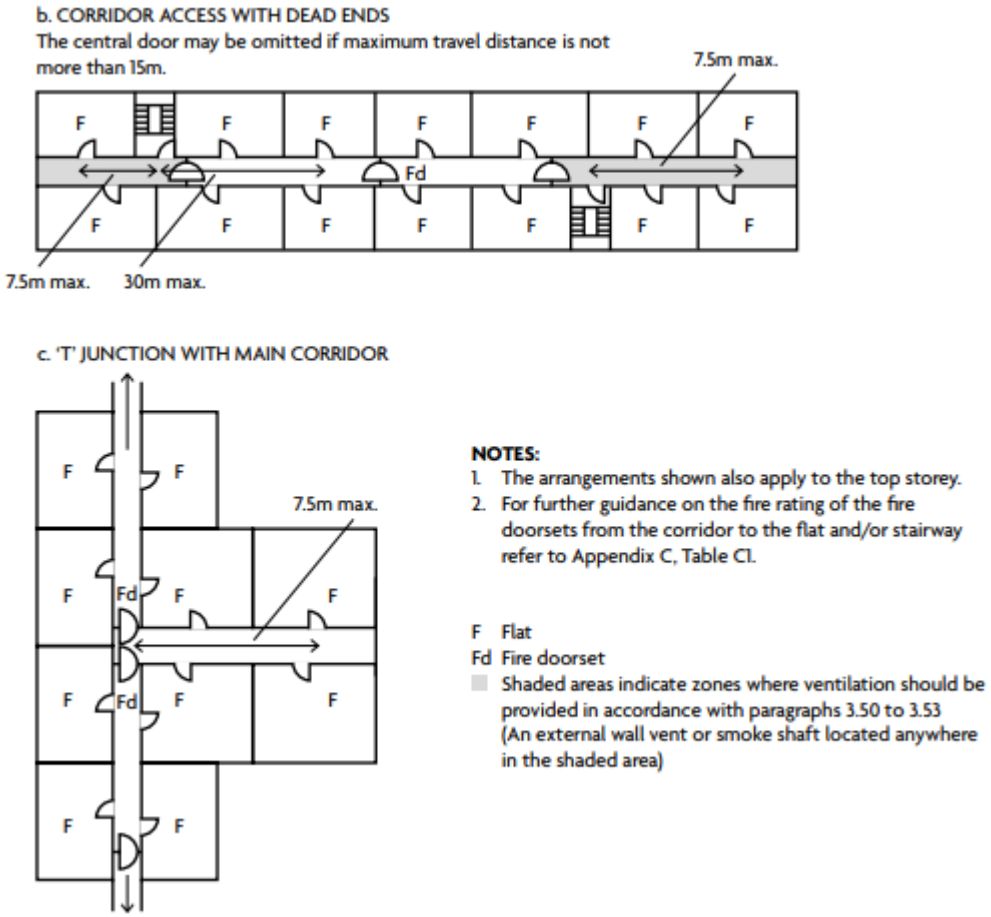

Figure 18: Common escape stair in small single stair building: Approved Document B Volume 1 B1, Diagram 3.9

5.4.4. As indicated in Figure 18 above, ADB clearly limits dead ends to a maximum 7.5m in blocks of flats (Purpose Group 1: Residential) which is applied to typologies 1, 2 and 3. The assumptions behind the time it takes to walk this distance, which informed this provision, are not necessarily applicable or relevant to for the resident profile for these typologies, there therefore may be a case for the next stages research considering whether this distance should be reduced or for the introduction of additional fire safety measures.

5.4.5. Depending on the layout of the building, emergency egress through common areas during fire incidents are dependent on staff response, occupant's fire safety behaviour and initial response in the event of fire alarm activation. BRE's guidance on evacuating occupancies with vulnerable people[43] is based on studies of evacuation and provides a possible framework that could be used when looking at the likely needs of residents in such buildings.

5.4.6. New research studies between private and academic institutions in Canada[44] have broadened the knowledge on emergency egress in care homes and specialised housing by considering their fire drill movement times. Depending on the resident's reaction time, responsible personnel's reaction time, and various limitations on residents' mobility, safety guidelines are challenged to adapt to the needs and abilities of building type occupants using the results of realistic tests. These types of trials and approaches have begun to consider human behaviour and resident's limitations as an important calculation to improve fire safety procedures, building design layout and fire training strategies for residents and responsible personnel in care homes and specialised housing. Although this research has not as yet influenced policy in Canada due to the fact that it was only completed last year, it does substantiate the findings of our qualitative survey within this research study.

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43 Crowder and Charters, FB 52 Evacuating Vulnerable and Dependent People from Buildings in an Emergency (BRE Trust, 2013).

44 Folk, et al., Emergency Egress for the Elderly in Care Home Fire Situations (Arup & York University, 2020).

5.5. Fire Alarms

5.5.1. The survey responses indicate the following issues around activation of the fire alarm system:

- There were few instances where residents had tampered with the system
- Burning of toast or food seemed to be a common theme for unintended activation
- The testing of the communal fire alarms did not cause much confusion for residents, although confusion is slightly higher for residents in care homes (typology 5) compared to the other typologies.

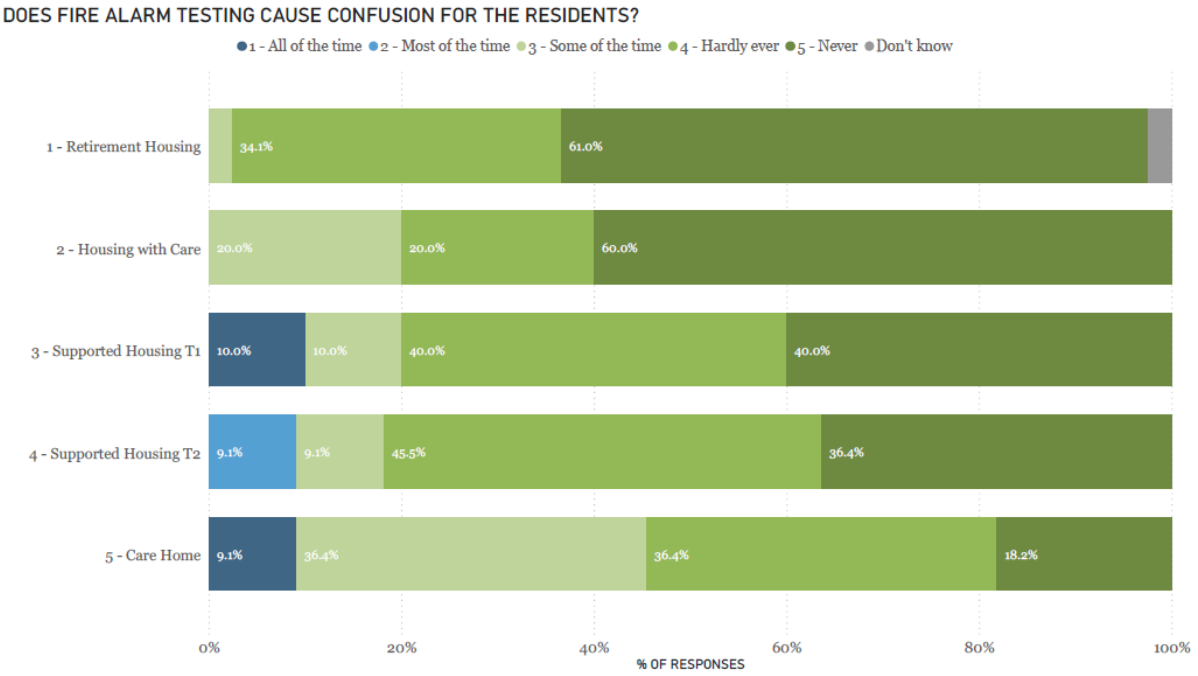

Figure 19: Confusion caused by fire alarm activation, Appendix 1 Quantitative Analysis Page 121

5.5.2. There is a general acknowledgement within the sector that in applying ADB, specialised housing typologies 1 to 3 sit in a 'grey' zone between general needs housing (Purpose Group 1: Residential Dwellings) and care homes (Purpose Group 2(a): Residential Institutional) resulting in a hybrid approach in the application of ADB Volume 1 and Volume 2 to both the design and management of these buildings. In practice, fire alarm systems and the approach taken in creating Fire Risk Assessments often take this hybrid approach. A hybrid approach to the fire alarm system in the flats is described in ADB Vol 1 (Dwellings), within the sheltered housing para, whereas the common and communal parts follow ADB Vol 2 (Buildings other than dwellings).

5.5.3. From the interviews conducted, the basic objectives of the hybrid approach to fire detection and warning arrangements in typologies 1 and 2, are as follows:

a) to alert residents in the flat of fire origin to enable their early evacuation, with the remaining flat alarms typically not activated. It alerts staff handsets and warden call/remote monitoring to allow staff time to investigate and reset in say a burnt toast scenario,
b) to result in the summoning of the fire and rescue service to the fire, so facilitating their early attendance (and, where relevant, action by staff), while avoiding, as far as practicable, attendance to false alarms,
c) early detection of a fire in any communal facilities (such as lounges or laundries) that might grow to affect common escape routes; this permits a warning to be given within escape routes threatened by fire, ensuring that such areas are evacuated and not entered by residents. Remaining flat alarms typically are not activated, and
d) Where relevant fire alarm interfaces with warden staff handsets/remote monitoring/call fire brigade to provide alert and activation of other life safety functions such as lifts

returning to ground, free swing door closers and door hold opens activate, automatic doors fail safe to open, smoke curtains deploy as well as mechanical smoke extract vent systems, automatic opening smoke vents, emergency generator etc.

5.5.4. This hybrid approach is to some extent supported by the reference to sheltered housing within ADB. For example, independent dwellings would require a system designed to BS 5839-6. In this regard, retirement and housing with care (typologies 1 and 2) could be considered as sheltered housing falling outside purpose groups 2(a) or 2(b) requiring the common parts therefore to have an alarm system designed to BS 5839-1. However, supported housing type 1 (typology 3), although it consists of independent dwellings has minimal communal facilities and therefore tends to fall within 2(a), thus requiring a system designed to BS 5839-1.

5.6. Management Issues

5.6.1. Issues regarding responsibility also arise when separate organisations are involved in the management of the same building e.g. a housing management company which is a different organisation to the company responsible for care delivery. This is often the case for the housing with care and supported housing type 1 models (typologies 2 and 3). The main issue being that the housing management organisation, who are only on site during the working week, is deemed to be the 'responsible person' whilst the care organisation is on site 24 hours a day and would therefore need to manage evacuation in the event of a fire.

5.6.2. One of the biggest issues for resolution and consistency is around evacuation and for some residents the need to be assisted by staff to evacuate. This is linked directly to levels and hours of staffing and their ability to discharge their duties under the FSO. Where staff are not on site 24 hours a day, such as in retirement housing, fire alarm activation often goes to a care call centre, which then contacts the fire service, who in turn then end up having to manage the evacuation due to a lack of onsite staff as well as undertaking firefighting.

5.7. Fire Risk Assessment

5.7.1. From the interviews it became apparent that there is substantial variation in the quality of fire risk assessments at design stage, as well as management of fire risks across different organisations, ranging from the highly specific to the worryingly vague. Many legacy Fire Risk Assessments are so generic on the specific conditions of a building as to be deemed useless by some of the managers we interviewed. It would seem that a greater management of evacuation in practice is required, specifically for the specialised housing typologies which fall into Purpose Group 1 Residential Dwellings.

5.7.2. The benefit of digital cloud-based Fire Risk Assessments as compared to paper-based ones was clear. Digital cloud-based tools allowed different individuals and organisations to upload checks and audits with the re-assurance that it is all stored in one safe place and crucially available to access quickly by others. Regardless of the approach to Fire Risk Assessment storage, premise based FRAs are often not produced until after buildings are completed creating a disconnect between compliance with ADB and the building in operation. It is therefore suggested that the next stage research considers that the fire risk assessment process should start during the building design process as a formal fire strategy which is submitted with the Building Regulations application.

5.7.3. The requirement of being able to start designs with a clearly defined and well understood evacuation strategy, possibly from a suite of choices, and a clear understanding of the intended users of the building and their management, in terms of their capabilities and needs, is of paramount importance to designers and operators alike. More clarity within ABD would allow for designing solutions which make additional allowances for the typologies/user groups which are not currently clear under ADB. For typology 1, 2 and 3 schemes, ADB could consider the inclusion of passive measures such as larger stairs, sub compartmentation and lobbies and additional cross corridor doors to provide refuge location and the possibility of phased evacuation including evacuation lifts, as currently defined in BA9991. This would mitigate where staff ability to manage evacuation is limited. This would provide some aspects of the care home approach whilst avoiding the potential under provision of a general needs apartment building design using the ADB guidance.

6. Fire Incident Data and Related Guidance

6.1 Many of the Fire Authorities investigating post-fire incidents and regulating fire safety within these care homes and specialised housing, have described in reports and collected datasets, certain overlapping issues and considerations that fall under the specific categories:

- Circulation: Fire Escape
- Design: Compartmentation & form of construction
- Management: Supervision
- Behaviour: Guidance vs Reality.

6.2.1. Our research has indicated that some of these categories require technical revision to ADB to better reflect the range of needs of intended occupants, compartmentation being one of them. Within 2014-2019 a large proportion of the recorded fire incidents where smoke and heat spread beyond the room of fire origin, were due to compartmentation issues. The main reasons included lack of adequate fire stopping, breaches in wall and ceiling cavities, and no suitable separation of the different occupancies and uses between ground and first floor premises[45]. It is understood that these compartmentation defects were a combination of design and construction defects as well as issues caused by work during occupation of the building which damaged the integrity of the compartmentation. Although not specific to this research, such issues call for specific remediation strategies by authorised registered and accredited consultants – i.e. passive fire protection investigations – and potentially specific training for operational firefighting personnel to recognise signs of compartmentation failure affecting fire development. Our research also supports the need for better oversight at the time of design and construction to ensure compliance with the Building Regulations as well as potentially a review of ADB's guidance on compartmentation to ensure it is clear and definitive for the specialised housing and care home sector.

6.2.2. The categories listed above, rather than relying on technical expertise, rely heavily on functions relating to building management and occupation to be successful. An example of this can be seen with the category of circulation. The location of fire incidents between 2014 to 2020 mainly occurred in the kitchen or bedroom of the care home or specialised housing building[46].

6.2.3. Although care homes and sheltered housing have been found not to be within building types with the highest percentages of fire mortality, it should be noted however that if wider research could be undertaken into building types with the highest levels of multiple fatalities in an individual fire incident, it might show care homes to be at greater risk. A common issue preventing adequate fire egress relates to the responsibility for management of the evacuation process lying with the building's operational staff team. Many fire reports have reported that one of the main issues is the lack of procedural knowledge within the management and staff team as well as control of fire safety arrangements.

6.2.4. While some arrangements are made consciously to improve residents' daily mobility and use of the building e.g. fire doors propped open for easier passage, other fire safety knowledge is typically not thought of or connected as being a building management issue. This can be seen with mobility scooters as highlighted in section 4.4 of this report, which have been found to produce large volumes of toxic smoke, instigating untenable safety conditions in less than 3 minutes[47].

6.2.5. Standards of automatic detection and sprinkler coverage in large voids and roof spaces and the level of compartmentation of such spaces may be critical given experience of fires in specialised housing schemes over recent years. The following are fire events where the fire spread to the roof space and laterally within the space. As a result, the building was partially destroyed at the time of the event and at least all or part of the building was made uninhabitable.

New Grange Care Home, Stevenage, 2017 – 2 fatalities
Chingford care home 2018 – 1 fatality
Storey Court, Bushey, 2012 – No fatalities

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45 LFB, Care Home Fires and Specialised Housing Fires redacted, 2014 - 2019, (LFB, 2020)
46 LFB, Compartmentation Issues, For periods Quarter 3 2018/19, (LFB, 2020);
47 LFB, Care Home Fires and Specialised Housing Fires redacted, 2014 - 2019,(:LFB, 2020).

Croft Residential Care Home, Sunderland, 2020 – No fatalities
St David's nursing home, Redcar, 2013 – No fatalities
Elm Tree Court, Huntingdon, 2018 – No fatalities
Beechmere, Cheshire, 2019 – No fatalities

6.3. Review of Fire Safety Guidance

6.3.1. ADB requires automatic fire detection Category L1 coverage, for care homes with horizontal evacuation strategies, and does not provide guidance to ensure the early response of staff members to compliment this standard of fire alarm. ADB is reliant on compartmentation, which is potentially problematic given the number of failures in compartmentation found within fire incident reports and data. These defects are primarily due to failures in construction workmanship rather than as a result of gaps in the ADB provisions.

6.3.2. Although the Building Regulations in Scotland do not provide a separate category for specialised housing, recently published government guidance[48] for the sector does extend to those responsible for managing specialised housing and those who provide care and support. The guidance, based on NFCC guidance for England[49], outlines where expectations for management of these building typologies are likely to vary from general needs apartments, all of which fall under the same guidance under ADB Purpose Group 1 for residential dwellings, with limited reference to sheltered housing. Although ADB is clear that unrealistic or unsustainable management provisions mean that the design cannot be considered to have met the requirements of the regulations, the management regime is often not fully considered until after the completion of the building.

6.3.3. Both the Scottish government and NFCC guidance recognise that, whilst the Building Regulations ensure a basic level of fire safety in residential premises, additional measures may need to be considered for specialised housing in practice, none of which is included within ADB. Both documents outline areas where these premises differ from general needs housing in terms of fire safety, a summary of which is outlined below.

- Stay put evacuation strategy is considered appropriate for specialised housing typologies 1 and 2, although some simultaneous evacuation may be required.
- Simultaneous evacuation is considered appropriate for supported housing, typologies 3 and 4.
- Alarm systems for communal areas with remote monitoring should be implemented with the potential exception of typology 1.
- Person centred fire risk assessments should be carried out in addition to premise-based ones.
- Storage and charging of mobility scooters should be considered.
- An escape window (as allowed within ADB for dwellings with no floor above 4.5m) is not considered appropriate for this use group.
- Slightly increased travel distances of up to 3m might not require additional measures, although more significant deviations may require compensatory measures.
- Additional measures may be needed for those unable to use stairs, such as temporary waiting spaces within a protected stair or lobby.
- Evacuation lifts can be used for vertical escape during a fire.

6.3.4. Fire Safety Risk Assessment Residential Care Premises[50] and Scottish guidance[51] provide the following categories for care homes (typology 5):

- **Low dependency** describes residents who have the physical and mental capability to respond to a fire emergency and exit the premises unaided or with minimal staff assistance.

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48 Scottish Government, Practical Fire Safety Guidance for existing Specialised Housing and similar premises (The Scottish Government, 2020).

49 National Fire Chiefs Council, Fire Safety in Specialised Housing (NFFC, 2017).

50 HM Government, Fire Safety Risk Assessment Residential Care Premises (Department for Communities and Local Government, 2006).

51 Scottish Government, Fire safety guidance for care homes (The Scottish Government, 2014).

- **Medium dependency** describes residents who either: (a) require physical assistance or guidance from a staff member to respond appropriately in a fire emergency; or (b) can exit the premises unaided, but will take an extended time to achieve this.
- **High dependency** describes residents who are totally dependent on staff and may require the assistance of two or more staff members in a fire emergency.

6.3.5. These categories of dependency are helpful for care homes where resident profiles may vary over the life of a building with a direct impact on fire safety, such as travel distance and expected evacuation time. A similar approach for specialised housing in England would be worth exploring in the next stage research, alongside an acknowledgment within ADB that these typologies and their residents differ from those anticipated within Purpose Group 1: Residential.

6.3.6. The evidence supports that purpose groups, evacuation strategies and compartmentation should be the subjects of further research, particularly for the specialised housing categories.

7. Evidence from Other Countries

7.1 A review of regulations from other countries was sought to provide comparative approaches to classifications of specialised housing and care homes, their relevant fire safety guidance and routes to compliance. This data was compiled through interviews with architects and fire specialists, where this was possible, and a high-level internet-based review of the country's regulations. The regulations were explored in a mix of countries worldwide and included New Zealand, Australia and the USA which have more mature later living sectors compared to the UK. An analysis of the findings for each country is outlined below.

7.2. Australia

7.2.1. The Australian National Construction Code (NCC) classifies buildings from Class 1 to Class 10, with some sub-classifications, e.g. Class 1a, and uses the terminology of a 'sole occupancy unit' as defined in Figure 20 below.

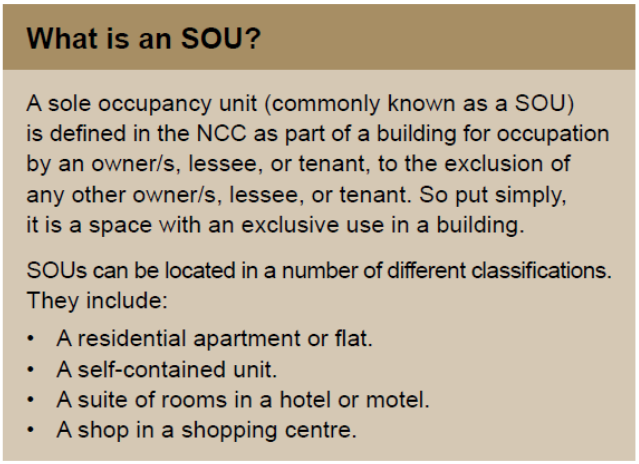

Figure 20: Sole occupancy unit definition NCC, extract from Building Classifications, Understanding the NCC

7.2.2. The document Building Classifications, Understanding the NCC, published by the Australian Building Codes Board (ABCB)[52] provides a very useful summary guide to the classes and is used as a preamble to the actual regulations. The classification of building types (Classes) relevant to specialised housing and care home are outlined in Figure 20, and are listed broadly in line with ascending care needs;

52 *ABCD, Building Classifications, Understanding the NCC (Australian Building Codes Board, 2020).*

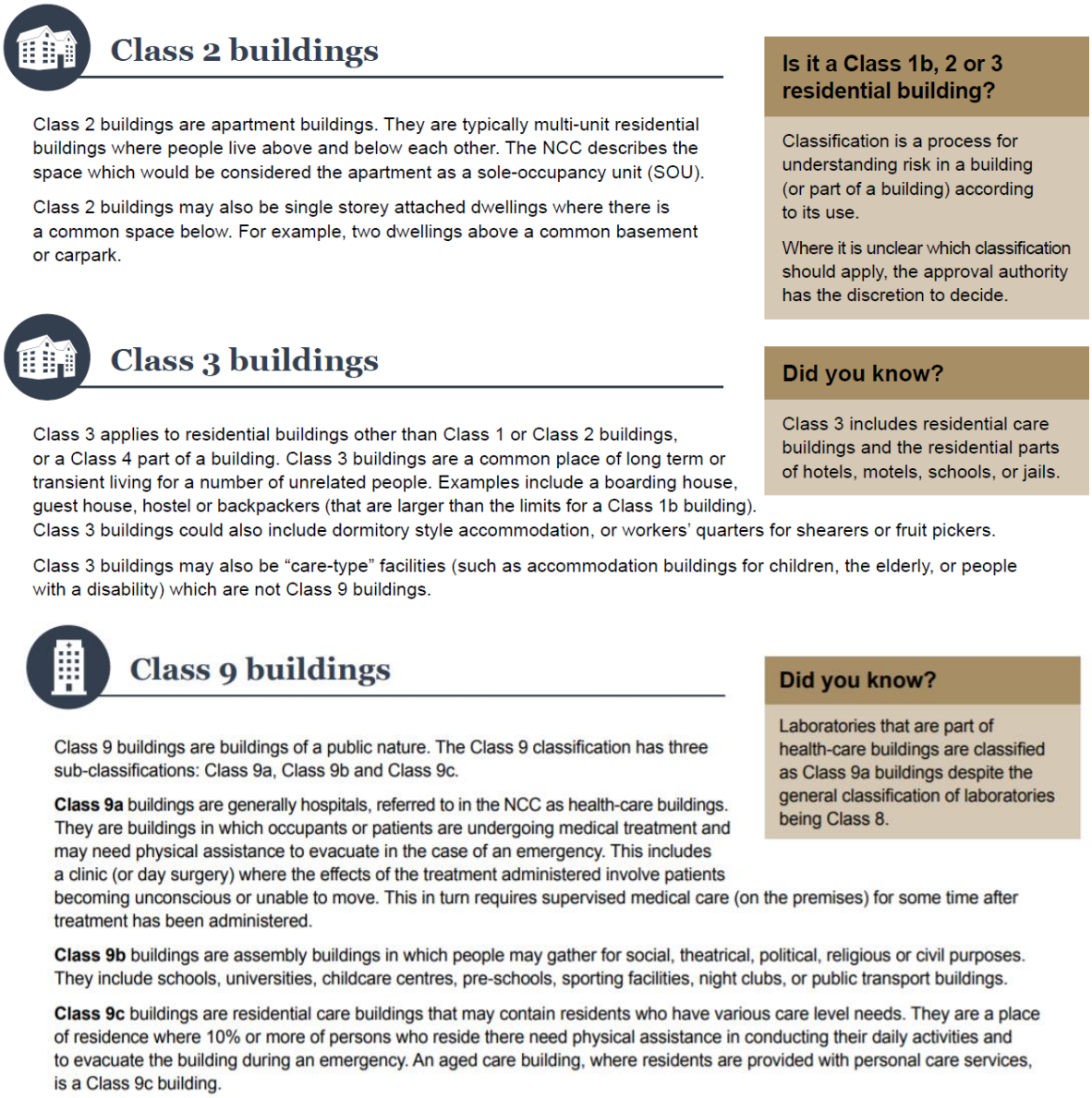

Figure 21: Australian building classifications pertaining to specialised housing and care homes, defined by NCC

7.2.3. The Building Code of Australia[53] provides regulations pertaining to fire safety which are divided into two volumes, depending on the use class for the building; Volume 1 covers classes 2 to 9 (i.e. including 3, 9a and 9c) and Volume 2 classes 1 and 10. These provide 'deemed to satisfy' ways to compliance but do not preclude alternative solutions.

7.2.4. Volume 1 provides a useful description of the relationship between class 3 and 9c with a more detailed coverage of the classes than the summary document as outlined in Figure 22 below.

53 *National Construction Council (NCC), Building Code of Australia 2019 Volumes 1 and 2, Amendment 1 (Australian Building Codes Board, 2019).*

Class 9c buildings are *residential care buildings* that may contain residents who have various care level needs.

The Class 9c classification recognises that many residents progress through a continuum of care needs from low to high. Many older people enter residential care with low care needs (typically Class 3 facilities) but, as they age, require higher levels of care. In the past, such progression often necessitated the transfer of a hostel resident (Class 3) to a nursing home (Class 9a). This frequently had negative consequences for the health and well-being of the resident, for whom the hostel accommodation was home. It also led, at times, to the separation of couples with differing care needs.

Building designers should note that Class 3 buildings include hostels for the accommodation of the aged, and Class 9a buildings include nursing homes. It is important to be aware, however, that construction of Class 3 or 9a buildings may restrict the options available to the operators of a facility in relation to the profile of the residents they wish to accommodate. Where the potential exists for residents of varying care needs to be accommodated, consideration of the Class 9c provisions may be appropriate. The Class 9c classification allows for any mix of low and high care residents and is intended to allow the mix to change as the residents' care needs change over time, without the need to obtain any further consent or approval from the *appropriate authority*.

Multi-care level facilities are for residents who may require the full range of care services outlined by the Aged Care Act. Hence, it is not intended to restrict the resident type and provides maximum flexibility for service providers, residents and the community.

The NCC provisions for Class 9c buildings are based on minimal on duty on-site staff being available at any time. However, it is recognised that the staff numbers vary throughout the course of any one day, due to the care needs of the residents and the functioning of the facility. It is also recognised that the specific care needs of the residents may result in a greater minimum number of staff.

Figure 22: Relationship between Class 3 and 9c, Pages 38 & 39 NCC, Building Code of Australia 2019

7.2.5. This recognises that the housing with care (research typology 2) and care home (research typology 5) models are likely to contain residents who have various levels of need and that many will progress through a continuum of care needs from low to high whilst in occupation.

7.2.6. Unlike the UK, the continuum of care is outlined within use classes ranging from general needs apartments through to care home. In addition, Class 3 differs from the UK (sheltered housing/retirement flats – typology 1) in that it could be a flat but more often is a room or studio which sits within the SOU definition as described above.

7.2.7. Flats are also used, principally in the private retirement sector, as the unit of accommodation. This puts them into class 2. Care typically delivered to the resident is 'domiciliary' care. However, it is acknowledged that where 'age in place' is to be expected and there is a 24-hour staff presence, the 9c measures would be added on top of the class 2 flat approaches as a prudent approach by designers and owners. Essentially full-time age-related care leads to the requirement for class 9c.

7.2.8. Interestingly there is a similar situation in the UK with housing with care in flats (i.e. typology 2 within this research project). However, the UK default approach is to follow the flats approach (Purpose Group 1) with some modifications for sheltered housing, rather than go up the chain of care need and apply care home regulations as relevant, i.e. the approach taken in Australia.

7.2.9. The (NCC) Australian regulations therefore clearly describe the requirements for the different classifications and apply the following in regards to fire safety (Volume 1):

7.2.10. **Resident care needs profile and classification:** As far as classification is concerned where 24-hour staffing is going to be provided as well as personal, age related care services for resident class, 9c is applicable. It was noted that dementia care does not trigger this requirement on its own because it is not necessarily age related.

7.2.11. **Means of escape:** For means of escape, multiple routes, numbers of stairs etc, Class 2 and 3 are treated similarly, whereas 9c and 9a sit together separately.

7.2.12. **Evacuation:** Classes 9c and 9a both employ phased evacuation with 24-hour staff assistance to evacuate the residents in an emergency. Class 3 sits with class 2 flats with similar provisions regarding means of escape.

7.2.13. **Compartmentation:** Classes 9c and 9a both divide the building into compartments based on a m^2 area maximum rather than the number of bedrooms. However, the effect is much the same

as in UK care homes resulting in max 5-10 bedrooms. Class 3 hostels however are not compartmented in this way but rather each bedroom is considered a compartment. This is the same approach as a class 2 flat and it's because both units of accommodation are classified as an SOU as described in Class 3 above, whereas in 9c and 9a the bedrooms do not have this status as is the case in a UK care home. Fire resistance requirements of class 2 and 3 are similar as are those of 9c and 9a.

7.2.14. **Units of accommodation:** Classes 3, 9c and 9a are typically made up of bedrooms with en-suite showers. Dining/kitchen facilities are communal. There are staff and other facilities. Retirement villages comprising apartment units of accommodation exist.

7.2.15. **Active Systems**: Sprinklers are required in all class 9c and 9a and class 3 where the residents are elderly. Alarm functionality is similar to UK care homes. Sprinkler activation calls the fire brigade, heat and smoke alert calls the staff first to allow them to investigate and reset as appropriate. The remainder of class 3 hostels and all class 2 flats only require sprinkler protection above a set height. This is currently under review to determine if sprinkler provision should be included with associated reduction elsewhere.

7.2.16. **Products and materials:** Internally and externally the fire performance of these is more stringent in 9a and 9c than in class 2 and 3.

7.2.17. **Fire Brigade access:** Similar to the UK, this is generally limited by hose lengths.

7.2.18. **Risk assessments and management procedures:** Compliance comes from following the codes so evacuation times and staffing levels are specifically not referred to in the code as it is deemed to be addressed through the alternative approaches highlighted above. The view of the Australian sector specialist architect interviewed was that 9c and 9a NCC requirements provide a very robust and safe approach. However, there are systemic issues of under staffing for care provision, let alone assisted fire evacuation. This is currently the subject of a long running Royal Commission into the whole aged care sector which is considered to require significant overhaul[54].

7.2.19. **Use and storage of mobility scooters:** These are typically stored externally in shelters rather than within buildings. The sector specialist Architect reported that in his experience these are typically underused, compared to the UK. The codes do not specifically describe facilities for them.

54 Royal Commission into Aged Care Quality and Safety, Interim Report (Royal Commissions, 2019).

7.3. New Zealand

7.3.1. New Zealand uses a class approach as set out in the New Zealand Building Code Clause A1 General Provisions – Classified Uses[55], see extract below.

> **2.0 Housing**
>
> **2.0.1** Applies to *buildings* or use where there is self care and service (internal management). There are three types:
>
> **2.0.2 Detached dwellings**
>
> Applies to a *building* or use where a group of people live as a single household or family. Examples: a holiday cottage, boarding house accommodating fewer than 6 people, dwelling or hut.
>
> **2.0.3 Multi-unit dwelling**
>
> Applies to a *building* or use which contains more than one separate household or family. Examples: an attached dwelling, flat or multi-unit apartment.
>
> **2.0.4 Group dwelling**
>
> Applies to a *building* or use where groups of people live as one large extended family. Examples: within a commune or marae.
>
> **3.0 Communal residential**
>
> **3.0.1** Applies to *buildings* or use where assistance or care is extended to the *principal users*. There are two types:
>
> **3.0.2 Community service**
>
> Applies to a residential *building* or use where limited assistance or care is extended to the *principal users*. Examples: a boarding house, hall of residence, holiday cabin, *backcountry hut*, hostel, hotel, motel, nurses' home, retirement village, time-share accommodation, a work camp, or camping ground.
>
> **3.0.3 Community care**
>
> Applies to a residential *building* or use where a large degree of assistance or care is extended to the *principal users*. There are two types:
>
> (a) **Unrestrained**; where the *principal users* are free to come and go. Examples: a hospital, an old people's home or a health camp.
>
> (b) **Restrained**; where the *principal users* are legally or physically constrained in their movements. Examples: a borstal or drug rehabilitation centre, an old people's home where substantial care is extended, a prison or hospital.

7.3.2. It is clear that there is a continuum of care anticipated through the use classes ranging from 2.0 housing through to 3.03 care homes, which is not the case in the UK.

7.3.3. New Zealand Building Code Clauses C1-6 covers protection from fire for all buildings. There are associated Acceptable Solutions documents which can be referred to and provide the more defined route to compliance for each typology.

7.3.4. The publication, Commentary for Acceptable Solutions C/AS1 to C/AS7[56] complements this by providing commentary on how to apply the code in practice, setting out the fire risk groups which determine which acceptable solution document can be followed.

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55 *New Zealand Government, The Building Regulations 1992, Reprinted 2017 (Ministry of Business, Innovation and Employment, 2017).*

56 *New Zealand Government, Commentary for Acceptable Solutions C/AS1 to C/AS7 (Ministry of Business, Innovation and Employment, New Zealand, 2013).*

C/AS2	SM	All multiple unit accommodation *buildings* not included in *risk group* SH. Note: there are some minor differences in requirements depending on whether the accommodation is considered permanent (ie, the occupants would be considered to be familiar with the *building* and its features) or temporary. Apartments and flats are considered permanent accommodation, while hotels, motels, hostels, serviced apartments and similar *buildings* are considered temporary accommodation. The Acceptable Solution for this *risk group* also specifies particular *fire* safety requirements for education accommodation, which has been singled out because of its particular nature. This category includes boarding schools (both primary and secondary education) and university halls of residence. **Not included**: Early childhood education (see *risk group* CA).
C/AS3	SI	All *buildings* or spaces where care is provided to occupants that are incapacitated in some way, are unable to evacuate unaided for any other reason, or would be delayed in their evacuation. It includes detention spaces in police stations and courthouses (but not prisons) and hospitals (excluding special care facilities such as places using general anaesthetic, hyperbaric chambers etc), residential care homes and hospices. It also includes clinics that provide medical day treatment that requires the incapacitation/sedation of those undergoing the treatment; for example, by kidney dialysis, dental procedures or chemotherapy. **Not included**: Early childhood education (see *risk group* CA)

Figure 23: Extract from Table 1: Description of risk groups and Acceptable Solutions[57]

7.3.5. Classification SM (flats) refers to acceptable solutions document C/AS2 and classification SI (institutional and care home) refers to acceptable solution C/AS3.

7.3.6. Therefore, the design approach to fire safety for class use 3.0.2 where limited assistance/care is provided including retirement (equivalent to retirement housing typology 1), is as the same as general needs flats. However, it is the level of care which dictates SI risk rather than the exact building form/unit of accommodation.

7.3.7. Occupancy load is used to calculate number of anticipated occupants as the starting point for assessment. The basic approach is to create 'fire cells' which divide buildings into fire protected compartments, shafts and floors. The size of fire cells is the most limited (max 500m^2) in SI. Fire resistance requirements are higher for SI than SM.

7.3.8. Risk group SM only requires sprinklers above certain heights. However, for SI:

> *The requirements for fire safety systems for risk group SI reflect that the occupants are largely incapacitated or prevented from self-evacuating. So early warning by smoke detection is required and the building needs to be protected with an automatic fire sprinkler system to provide additional time for an evacuation.*

7.3.9. In addition, SI must also have smoke control systems and a specific fire alarm system. SM requirements for alarm system vary with size and height.

7.3.10. Means of escape is based on similar principles to ADB regarding a choice of escape routes, limited dead ends and escape stairs etc. For SM, the dead-end length can vary with height. For SI dead ends are limited by the number of occupants. SI has more onerous escape distances with a single storey exit never permitted. In addition, for SI:

57 *New Zealand Government, The Building Regulations 1992, Reprinted 2017 (Ministry of Business, Innovation and Employment, New Zealand, 2017)*

> **C/AS3: Means of escape for risk group SI:** While the general principles for means of escape apply to *risk group* SI, the requirements of Acceptable Solution C/AS3 reflect the fact that, if a *fire* occurs, the occupants of these *buildings* will be delayed, will require assistance, will be moved to a *place of safety* before leaving the *building*, or may not leave the *building* at all. However, escape to a *safe place* outside and away from the *building* must be provided. This is because it is not sufficient to assume that people will be able to remain in the *building* as *fire* is a dangerous and unpredictable phenomenon. In spite of all mitigating measures taken during *fire* design and the actions of the Fire Service, it may be necessary to evacuate the *building* at any time during a *fire* event.

Figure 24: Means of Escape for risk group S1[58]

7.3.11. In New Zealand, unlike the UK, all buildings above 10m high require firefighter-controlled lifts regardless of typology. However, similarly to England, where lifts are required in an SI building they must be located fully within a fire protected shaft. Dry risers are required in buildings where any floor is above 15m are, rather than relying on hose lengths.

7.3.12. It is clear that there is a continuum of code use classes ranging from general needs apartment through to older people's home which is not the case in the England. However as far as fire is concerned the community service class (retirement) does not have its own risk class for fire. The risk class and therefore fire measures are dependent on the actual levels of care being provided which allows for the possibility of retirement developments falling into either of the two risk groups. How this is dealt with as a resident population ages and care needs increase is worth further research.

7.4. South Africa

7.4.1. The South African National Standard[59] sets out performance for all building regulations with use classes defined within Part A20.

7.4.2. The classified uses are as follows (listed with ascending care needs);

- H3 more than one dwelling unit on a site (flats).
- E3 Other institutional (residential) where care homes would sit.

7.4.3. The application of the National Building Regulations SANS 10400-T Part W[60] covers fire. These are deemed to satisfy documents which can be referred to and provide a route to compliance. The requirements for institutional residential buildings (category E3) are generally more onerous than flats (category H3) and rely on compartmentation and a phased evacuation approach.

7.4.4. The standard does not describe typologies sitting between flats and care homes with the E3 category approach, which is similar to ADB in terms of means of escape, compartmentation etc.

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58 New Zealand Government, C/AS1 Commentary for Acceptable Solutions for Buildings other than Risk Group SH (Ministry of Business, Innovation and Employment, New Zealand, 2019).

59 SABS, SANS 10400-A:2010 Edition 3, South African National Standard, The Application of the National Building Regulations Part A: General principles and requirements (SABS Standards Division, Nov 2010).

60 SABS, SANS 10400-T:2010 Edition 3, South African National Standard, The Application of the National Building Regulations Part T: Fire Protection (SABS Standards Division, Mar 2011).

7.5. Portugal

7.5.1. In Portugal Legislation/law n.º 224/2015[61] encompasses the regulatory fire safety provisions (segurança contra incêndio em edifícios, SCIE) applicable to all buildings and premises. This provides a fire safety framework for buildings that is homogeneously applicable throughout the national territory.

7.5.2. The main aspects of the Portuguese regulations include:

- buildings are classified in twelve types, according to their functions and uses
- each type of building is classified in four risk categories, depending on their construction characteristics, height, gross area, number of floors below the reference floor, expected number of occupants, etc
- building spaces are classified in six hazardous locations, depending on the activities, materials and the ability of occupants to understand and react to a fire alarm
- all buildings, regardless their construction date, are required to define and adopt an internal fire protection management system.

7.5.3. The general objectives of the Portuguese fire regulation framework for buildings are defined as:

> *Determine the minimum conditions to be met by the design, construction and layout of buildings in order to:*
> *(a) prevent the birth, development and spread of a fire;*
> *(b) ensure the safety of persons;*
> *(c) facilitate the intervention of the fire department*[62]

7.5.4. The standard uses, relevant to this research, are set out within the guidance and are defined as;

- *Type 1 housing single family dwellings (houses) and multifamily (apartments).*
- *Type 5 Hospitals and care homes.*

7.5.5. The standard uses do not provide any separate definition for specialised housing between Type 1 and 5.

7.5.6. Regulation n.º 1532/2008[63] contains the general and specific technical provisions of SCIE relating to external fire conditions, compartmentation, passive fire protection, evacuation, active fire safety systems installations, and fire safety management.

7.5.7. The fire measures within properties are implemented using a calculation based on a number of influences which include building height, the risk category of occupants and local risk areas (environmental factors), rather than simply the building use, which is just one contributing factor. There are only a small number of enhanced or additional provisions specifically for care homes and risk location D, beyond what is required for the relative risk category.

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61 Decreto-Lei n.º 224/2015 (Diário da República n.º 198/2015, Série I de 2015-10-09)

62 Extract from the CFPA Europe website: https://cfpa-e.eu/national-regulations/regulations-portugal/

63 Decreto-Lei n.º 1532/2008 (Diário da República n.º 250/2008, Série I de 2008-12-29)

7.6. USA – Florida

7.6.1. Chapter 3 section 302.1 of the Florida Building Code[64] covers use and occupancy classification.

1. *Assembly (see Section 303): Groups A-1, A-2, A-3, A-4 and A-5.*
2. *Business (see Section 304): Group B.*
3. *Educational (see Section 305): Group E.*
4. *Factory and Industrial (see Section 306): Groups F-1 and F-2.*
5. *High Hazard (see Section 307): Groups H-1, H-2, H-3, H-4 and H-5.*
6. *Institutional (see Section 308): Groups I-1, I-2, I-3 and I-4.*
7. *Mercantile (see Section 309): Group M.*
8. *Residential (see Section 310): Groups R-1, R-2, R-3 and R-4.*
9. *Storage (see Section 311): Groups S-1 and S-2.*
10. *Utility and Miscellaneous (see Section 312): Group U*

7.6.1. Residential group R is covered in Section 310;

310.1 Residential Group R.
Residential Group R includes, among others, the use of a building or structure, or a portion thereof, for sleeping purposes when not classified as an Institutional Group I or when not regulated by the Florida Building Code, Residential

310.4 Residential Group R-2.
Residential Group R-2 occupancies containing sleeping units or more than two dwelling units where the occupants are primarily permanent in nature, including:
Apartment houses

310.5 Residential Group R-3.
Residential Group R-3 occupancies where the occupants are primarily permanent in nature and not classified as Group R-1, R-2, R-4 or I, including:
Buildings that do not contain more than two dwelling units
Boarding houses (nontransient) with 16 or fewer occupants
Boarding houses (transient) with 10 or fewer occupants
Care facilities that provide accommodations for five or fewer persons receiving care
Congregate living facilities (nontransient) with 16 or fewer occupants
Congregate living facilities (transient) with 10 or fewer occupants
Owner-occupied lodging houses with five or fewer guest rooms and 10 or fewer occupants

7.6.2. Institutional group is covered in Section 308;

308.1 Institutional Group I.
Institutional Group I occupancy includes, among others, the use of a building or structure, or a portion thereof, in which care or supervision is provided to persons who are or are not capable of self-preservation without physical assistance or in which persons are detained for penal or correctional purposes or in which the liberty of the occupants is restricted. Institutional occupancies shall be classified as Group I-1, I-2, I-3 or I-4.

308.3 Institutional Group I-1.
Institutional Group I-1 occupancy shall include buildings, structures or portions thereof for more than 16 persons, excluding staff, who reside on a 24-hour basis in a supervised environment and receive custodial care. Buildings of Group I-1 shall be classified as one of the occupancy conditions specified in Section 308.3.1 or 308.3.2. This group shall include, but not be limited to, the following:
Assisted living facilities
Group homes
Residential board and care facilities
Social rehabilitation facilities

64 *Florida Building Code 2020, 7th Edition: Chapter 3: Use and Occupancy Classification (International Code Council, 2020)*

308.4 Institutional Group I-2.
Institutional Group I-2 occupancy shall include buildings and structures used for medical care on a 24-hour basis for more than five persons who are incapable of self-preservation. This group shall include, but not be limited to, the following:
Foster care facilities
Detoxification facilities
Hospitals
Nursing homes
Psychiatric hospitals

7.6.3. The definition of assisted living in section 464 is;

Any building or buildings, section or distinct part of a building, private home, boarding home, home for the aged or other residential facility, whether operated for profit or not, which undertakes through its ownership or management to provide housing, meals and one or more personal services for a period exceeding 24 hours to one or more adults who are not relatives of the owner or administrator.

7.6.4. Section 464 goes on to clarify what is exempt from classification as assisted living;

Any facility certified under Chapter 651, Florida Statutes, or a retirement community, may provide services authorized under this section or Part IV of Chapter 400, Florida Statutes to its residents who live in single-family homes, duplexes, quadruplexes, or apartments located on the campus without obtaining a license to operate an assisted living facility if residential units within such buildings are used by residents who do not require staff supervision for that portion of the day when personal services are not being delivered and the owner obtains a home health license to provide such services. However, any building or distinct part of a building on the campus that is designated for persons who receive personal services and require supervision beyond that which is available while such services are being rendered must be licensed in accordance with this section.

7.6.5. Therefore, the level of care is what separates Retirement from the Assisted Living use.

7.6.6. In summary the relevant uses with level of care increasing are;

- Residential Group R-2 includes apartments.
- Residential Group R-3 includes Care facilities that provide accommodations for five or fewer persons receiving care.
- Assisted Living Facilities and Group Homes I-1.
- Nursing Homes (licensed) I-2. These are not limited to older persons.

7.6.7. Chapter 4 section sets out further special detailed requirements based on occupancy and use, including;

I-1 includes Assisted living.
However, a facility housing not fewer than six and not more than 16 persons receiving custodial care shall be classified as Group R-4. A facility with five or fewer persons receiving custodial care shall be classified as Group R-3 or shall comply with the Florida Building Code, Residential provided an automatic sprinkler system is installed in accordance with Section 903.3.1.3 or Section P2904 of the Florida Building Code, Residential.

I-2 includes Nursing Homes.
However, a facility with five or fewer persons receiving medical care shall be classified as Group R-3 or shall comply with the Florida Building Code, Residential provided an automatic sprinkler system is installed in accordance with Section 903.3.1.3 or Section P2904 of the Florida Building Code, Residential.

7.6.8. The Florida Building Code sets out general fire measures for all buildings with further sections adding for specific building uses. The general measures include requirements such as length of

time for fire resistance which varies with the actual construction methods employed and which is set out in chapter 6. This is not an approach taken in ADB.

7.6.9. Occupant loads (number of persons) is calculated taking load factors for specific uses and multiplying with the floor area.

7.6.10. In addition, the number and length of escape routes permitted is determined by the number of people (load). The table below sets out how many exits are needed on this basis.

OCCUPANT LOAD PER STORY	MINIMUM NUMBER OF EXITS OR ACCESS TO EXITS FROM STORY
1-500	2
501-1,000	3
More than 1,000	4

Figure 25: Minimum Number of Exits or Access to Exits per Story (Table 1006.3.2, Florida Building Code)

7.6.11. The higher load of the I use class (1 person per 120ft²) compared to that of R-2 flats (1 person per 200ft²) set out in Chapter 10 1004.5, leads to a requirement for more escape routes due to more occupants. The table above does not indicate single escape is possible. However, it is permitted within the very limited constraints of the figure below.

7.6.12. As can be seen stories with single escape routes are not permitted above two stories for both the R and I use with a limit set load of 10 occupants per storey. This is a significant constraint as compared to ADB which does not limit single stair use anywhere near this extent.

STORY	OCCUPANCY	MAXIMUM OCCUPANT LOAD PER STORY	MAXIMUM COMMON PATH OF EGRESS TRAVEL DISTANCE (feet)
First story above or below grade plane	A, B[b], E F[b], M, U	49	75
	H-2, H-3	3	25
	H-4, H-5, I, R-1, R-2[a,c], R-4	10	75
	S[b,d]	29	75
Second story above grade plane	B, F, M, S[d]	29	75
Third story above grade plane and higher	NP	NA	NA

For SI: 1 foot = 304.8 mm.
NP = Not Permitted.
NA = Not Applicable.

a) Buildings classified as Group R-2 equipped throughout with an automatic sprinkler system in accordance with Section 903.3.1.1 or 903.3.1.2 and provided with emergency escape and rescue openings in accordance with Section 1030.
b) Group B, F and S occupancies in buildings equipped throughout with an automatic sprinkler system in accordance with Section 903.3.1.1 shall have a maximum exit access travel distance of 100 feet.
c) This table is used for R-2 occupancies consisting of sleeping units. For R-2 occupancies consisting of dwelling units, use Table 1006.3.3(1)
d) The length of exit access travel distance in a Group S-2 open parking garage shall be not more than 100 feet.

Figure 26: Storeys with One Exit or Access to One Exit for Other Occupancies (Table 1006.3.3(2), Florida Building Code)

7.6.13. The table below sets the maximum distances and number of occupants allowed in spaces (rooms) where there is a single direction of escape. It demonstrates that in use R-2, the length of escape (125ft) is longer than permitted in both the I-1 and I-2 classes (75ft). Similarly, in R-2 50 occupants are allowed in such spaces whereas in the uses it is limited to 10 people which at 120ft² per person equates to a space 111m².

OCCUPANCY	MAXIMUM OCCUPANT LOAD OF SPACE	MAXIMUM COMMON PATH OF EGRESS TRAVEL DISTANCE (feet)		
		Without Sprinkler System(feet)		With Sprinkler System(feet)
		Occupant Load		
		OL ≤ 30	OL > 30	
A,[c] E, M	49	75	75	75[a]
B	49	100	75	100[a]
F	49	75	75	100[a]
H-1, H-2, H-3	3	NP	NP	25[b]
H-4, H-5	10	NP	NP	75[b]
I-1, I-2,[d] I-4	10	NP	NP	75[a]
I-3	10	NP	NP	100[a]
R-1	10	NP	NP	75[a]
R-2	49	NP	NP	125[a]
R-3[e]	49	NP	NP	125[a]
R -4[e]	20	75	75	125[a]
S[f]	29	100	75	100[a]
U	49	100	75	75[a]

For SI: 1 foot = 304.8 mm.
NP = Not Permitted.

a) Buildings equipped throughout with an automatic sprinkler system in accordance with Section 903.3.1.1 or 903.3.1.2. See Section 903 for occupancies where automatic sprinkler systems are permitted in accordance with Section 903.3.1.2.
Group H occupancies equipped throughout with an automatic sprinkler system in accordance with Section 903.2.5.
b) For a room or space used for assembly purposes having fixed seating, see Section 1029.8.
c) For the travel distance limitations in Group I-2, see Section 407.4.
d) The common path of egress travel distance shall only apply in a Group R-3 occupancy located in a mixed occupancy building or within a Group R-3 or R-4 congregate living facility.
e) The length of common path of egress travel distance in a Group S-2 open parking garage shall be not more than 100 feet

Figure 27: Spaces with One Exit or Exit Access Doorway (Table 1006.2.1, Florida Building Code)

7.6.14. Chapter 9 sets out fire alarm requirements which are less onerous for R-2 with a cut off for provision for smaller buildings. Section 420 in chapter 4 requires sprinkler protection to R-2 use.

[F]420.5 Automatic sprinkler system.
Group R occupancies shall be equipped throughout with an automatic sprinkler system in accordance with Section 903.2.8. Group I-1 occupancies shall be equipped throughout with an automatic sprinkler system in accordance with Section 903.2.6. Quick-response or residential automatic sprinklers shall be installed in accordance with Section 903.3.2.

7.6.15. Chapter 4 Section 420 sets out the fire requirements for R2 and I1 some of which only apply to I-1.

420.1 General.
Occupancies in Groups I-1, R-1, R-2, R-3 and R-4 shall comply with the provisions of Sections 420.1 through 420.6 and other applicable provisions of this code.

420.2 Separation walls.

Walls separating dwelling units in the same building, walls separating sleeping units in the same building and walls separating dwelling or sleeping units from other occupancies contiguous to them in the same building shall be constructed as fire partitions in accordance with Section 708.

420.3 Horizontal separation.
Floor assemblies separating dwelling units in the same buildings, floor assemblies separating sleeping units in the same building and floor assemblies separating dwelling or sleeping units from other occupancies contiguous to them in the same building shall be constructed as horizontal assemblies in accordance with Section 711.

7.6.16. Additional fire requirements for use I-1 include separating walls to accommodation dwelling units and floors are described, similar to ADB for flats However, in addition the floors are divided into compartments by *smoke barriers* to provide refuge to residents moving from one compartment to another and sprinkler provision is required.

420.4 Smoke barriers in Group I-1, Condition 2.
Smoke barriers shall be provided in Group I-1, Condition 2, to subdivide every story used by persons receiving care, treatment or sleeping and to provide other stories with an occupant load of 50 or more persons, into no fewer than two smoke compartments. Such stories shall be divided into smoke compartments with an area of not more than 22,500 square feet (2092 m^2) and the distance of travel from any point in a smoke compartment to a smoke barrier door shall not exceed 200 feet (60 960 mm). The smoke barrier shall be in accordance with Section 709.

420.4.1Refuge area.
Refuge areas shall be provided within each smoke compartment. The size of the refuge area shall accommodate the occupants and care recipients from the adjoining smoke compartment. Where a smoke compartment is adjoined by two or more smoke compartments, the minimum area of the refuge area shall accommodate the largest occupant load of the adjoining compartments. The size of the refuge area shall provide the following:

1. Not less than 15 net square feet (1.4 m^2) for each care recipient.
2. Not less than 6 net square feet (0.56 m^2) for other occupants.

Areas or spaces permitted to be included in the calculation of the refuge area are corridors, lounge or dining areas and other low-hazard areas

7.6.17. Sprinkler provision is required to all Group I use buildings;

[F] 903.2.6 Group I.
An automatic sprinkler system shall be provided throughout buildings with a Group I fire area.

7.6.18. Chapter 4 Section 407 sets out the further fire requirements for use I-2;

407.4 Means of egress.
Group I-2 occupancies shall be provided with means of egress complying with Chapter 10 and Sections 407.4.1 through 407.4.4. The fire safety and evacuation plans provided in accordance with Section 1001.4 shall identify the building components necessary to support a defend-in-place emergency response in accordance with the Florida Fire Prevention Code.

7.6.19. Compartmentation is described with limits on open areas per compartment, with corridors for escape leading to final exits.

407.5 Smoke barriers.
Smoke barriers shall be provided to subdivide every story used by persons receiving care, treatment or sleeping and to divide other stories with an occupant load of 50 or more persons, into no fewer than two smoke compartments. Such stories shall be divided into smoke compartments with an area of not more than 22,500 square feet (2092 m^2) in Group I-2, Condition 1, and not more than 40,000 square feet (3716 m^2) in Group I-2, Condition 2, and the distance of travel from any point in a smoke compartment to a smoke barrier door shall be not greater than 200 feet (60 960 mm). The smoke barrier shall be in accordance with Section 709.

7.6.20. Refuges in each compartment allow occupants of one compartment to defend in place in an adjoining one with a choice of directions.

> ***407.5.1 Refuge area.***
> *Refuge areas shall be provided within each smoke compartment. The size of the refuge area shall accommodate the occupants and care recipients from the adjoining smoke compartment. Where a smoke compartment is adjoined by two or more smoke compartments, the minimum area of the refuge area shall accommodate the largest occupant load of the adjoining compartments. The size of the refuge area shall provide the following:*
> 1. *Not less than 30 net square feet (2.8 m^2) for each care recipient confined to bed or stretcher.*
> 2. *Not less than 6 square feet (0.56 m^2) for each ambulatory care recipient not confined to bed or stretcher and for other occupants.*
>
> *Areas or spaces permitted to be included in the calculation of refuge area are corridors, sleeping areas, treatment rooms, lounge or dining areas and other low-hazard areas.*

7.6.21. The approach is similar in principle to ADB for care homes. In addition, sprinkler protection is required.

> ***[F] 407.6 Automatic sprinkler system.***
> *Smoke compartments containing sleeping rooms shall be equipped throughout with an automatic sprinkler system in accordance with Sections 903.3.1.1 and 903.3.2.*

7.6.22. As with New Zealand, the Assisted living use is determined by the level of care being provided and the ability of the residents to escape and so a retirement development could fall into R-2 flats or I-1 use. How the increasing care needs within a retirement community impact on the in use, use class would be worthwhile exploring further.

7.7. Conclusions

7.7.1. It was notable from this research that there is significant difference between other countries' fire safety legislation and associated guidance, mainly due to their defined scopes of residential care homes and other forms of housing.

7.7.2. The international research highlighted a variety of approaches, some of which goes beyond that outlined in ADB guidance. Common themes which have emerged and are considered worthy of further consideration include;

- A wider spectrum of clearly defined use classes for specialised housing and care homes reflected within the regulations
- Anticipated mobility and impairments of the residents having a direct influence on the applicable use class
- General sprinkler protection as a requirement for certain use classes applicable to building typologies where residents have care needs
- The compartmentation for specialised housing beyond the dwelling, combines the requirements common areas in care homes in addition to that applied to general needs housing.

8. Wider Regulatory Landscape

The following may impact on relevant building types being considered by this research.

8.1 Building Regulations

8.1.1. The concurrent DLUHC research projects related to ADB could ultimately lead to the introduction of revised requirements. The means of escape for disabled people review may potentially lead to different provisions in terms of travel distances, corridor design, the provision of evacuation lifts, and guidance of refuge provision in residential buildings.

8.1.2. Some other areas of non-fire safety legislation may have fire safety implications:

- energy performance minimum standards will change with Approved Document L 2022 and further revisions in 2025 under the Future Homes and Future Buildings standards - this is likely to mean that larger amounts of combustible insulants are specified and installed in the facades of lower rise relevant buildings to achieve the required thermal performance.
- future heat energy systems will likely be electric and include heat pumps. Energy storage in batteries may become more prevalent and as such are likely to require safe enclosures
- electric vehicle charging points will be required under new legislation for some building typologies considered by this research
- the Part M review may include changes in Approved Document M which will affect relevant buildings considered by this research.

8.2. BS 9991

8.2.1. A review of this standard is being undertaken by BSI which will update and strengthen guidance for the sector. It may result in stronger recommendations for evacuation lifts, progressive evacuation etc within the standard.

8.3. Fire Safety Act

8.3.1. This legislation will strengthen the whole process of fire risk assessment and will no doubt create a tougher regime beyond the FSO. Existing buildings may become the subject of extra upgrading demands, also management plans and management resource allocation may be more stringently viewed. The legislation will not directly affect the design and construction of new buildings though.

8.4. Building Safety Act

8.4.1. It is currently understood that the Act will not include ‘care homes’ of any height but it may include sheltered housing apartment blocks where they have a top floor over 18m or are 7 storeys or above. Whether this happens or not, it is likely that the new building safety regime culture and process will flow into the specialised housing sector in procurement, design, compliance, duty holders, building management and responsibility terms.

8.5. London Plan

8.5.1. The London Plan requires fire safety to be considered from the outset of a development project, and not just at the Building Regulations application stage. Fire safety should consider the diversity and likely behaviour of the future building residents. The Plan highlights the following:

Policy D5 (B5) Inclusive Design requires development proposals to be designed to incorporate safe and dignified emergency evacuation for all building users. In all developments where lifts are installed, as a minimum at least one lift per core (or more subject to capacity assessments) should be a suitably sized fire evacuation lift suitable to be used to evacuate people who require level access from the building

Policy D12(A) Fire Safety states that development proposals must ensure that they:

1) Identify suitably positioned unobstructed outside space for:
a. fire appliances to be positioned on
b. appropriate for use as an evacuation assembly point

2) Are designed to incorporate appropriate features which reduce the risk to life and the risk of serious injury in the event of a fire; including appropriate fire alarm systems and passive and active fire safety measures
3) Are constructed in an appropriate way to minimise the risk of fire spread
4) Provide suitable and convenient means of escape, and associated evacuation strategy for all building users
5) Develop a robust strategy for evacuation which can be periodically updated and published, and which all building users can have confidence in

8.5.2. The London Plan therefore requires at planning application stage, an evacuation lift to be proposed in all new buildings with a lift, the development of an evacuation strategy which is later used and updated during the building occupation and construction solutions which minimise fire spread.

9. Objective 1: Findings and Recommendations

This section summarises the proposed recommendations for further research based on the findings, in our proposed order of priority.

9.1 Purpose Groups

9.1.1. The research has distilled the specialist housing and care building types in to the following primary typologies with their corresponding Purpose Groups under as currently defined by ADB:-

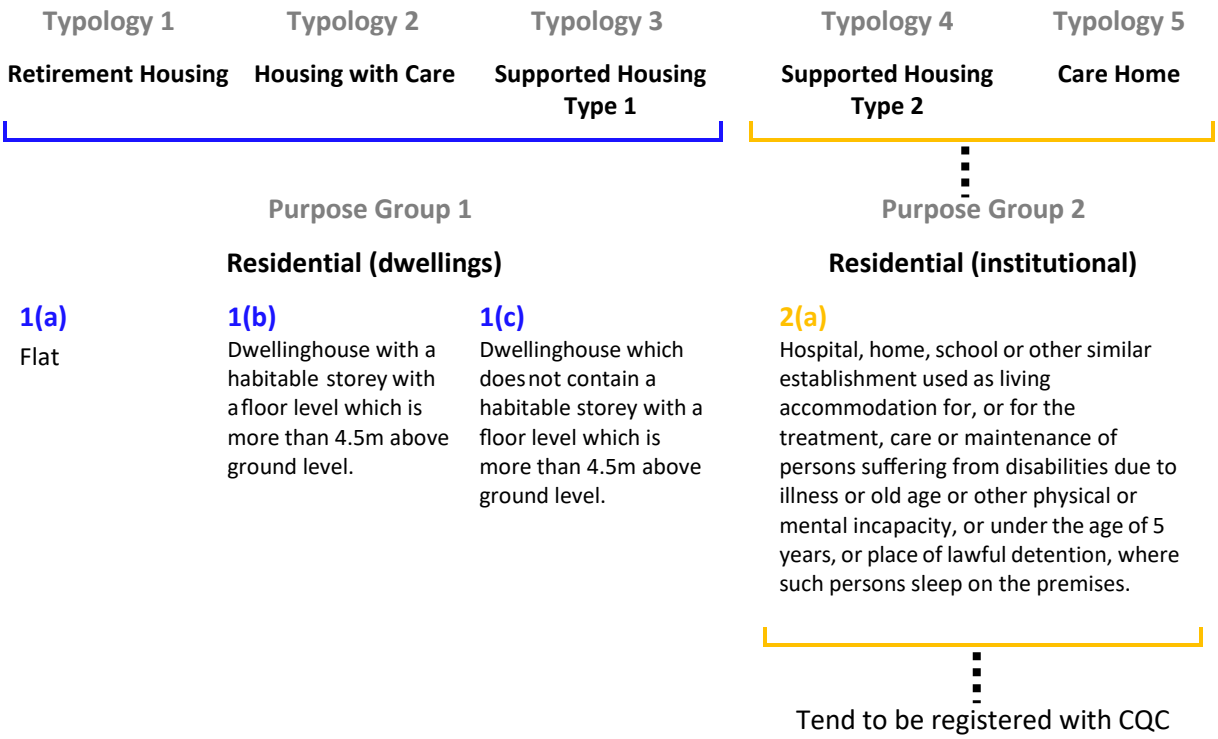

Figure 28: Typologies as defined within Table 1 mapped against Purpose Groups as defined in Table D1 of ADB

9.1.2. This research has highlighted a potential 'grey' area for specialised housing typologies 1 retirement living, 2 housing with care and 3 supported housing type 1. As these are individual dwellings they all sit within under Purpose Group 1 Residential Dwellings, with limited acknowledgement of any potential specific requirements of these particular residents. Reference to sheltered housing (i.e. typology 1) creates a hybrid scenario between parts of the regulations but is silent on typologies 2 and 3 leaving them open to interpretation. The international research has shown additional specialised housing purpose groups being used, beyond general needs housing. However, clearly a cautious approach must be taken in interpreting these given the varying legal, regulatory and cultural approaches to older persons housing and care in these countries. They do however demonstrate a spectrum of care which is more reflected in the use classes and applicable fire measures.

9.1.3. The research has highlighted that Building Control, and more so the Fire Brigade, question the current Use Class 1a, particularly with specialised housing typology 2, where they argue that the level of care and ability of the residents are, or could become, more akin to a care home irrespective of the unit of accommodation being flats.

9.1.4. The review of Scottish Building Regulations and associated government guidance[65] on specialised housing concluded that the approach adopted in Scotland provides a strong

65 *Scottish Government, Practical Fire Safety Guidance for existing Specialised Housing and similar premises (The Scottish Government, Jan 2020)*

framework to eliminate varying interpretation of the intent of the regulations. Whilst the NFCC guidance provides a similar framework for England, this guidance is not included in ADB.

9.1.5. Stage 2 of the research should therefore research expanding the Purpose Groups to create additional granularity and clarity around these typologies and define how ADB could address each of these, evidence for which can be seen in the international research reviewed in section 7.

9.2. Evacuation Strategy

9.2.1. The scoping study, review of other literature and management survey of the detailed case studies, have revealed some inconsistent approaches to evacuation strategies in specialised housing. Aging in place of the residents and limited staffing is a contributing factor. It is recommended that further research is undertaken into how ADB could further define evacuation strategies and how these should be informed by resident abilities, the fire risk assessments and management regimes.

9.2.2. For specialised housing buildings (typologies 1, 2 and 3), ADB does not describe measures which sit between the care home and general needs housing purpose groups. The management approach for such buildings, as outlined in the FSO guide, needs to be able to adapt with the changing profile of the resident population. It follows that the ADB guidance should also consider such changes in resident profiles.

9.2.3. For care homes (typologies 4 & 5) guidance in ADB is clear on progressive evacuation as the approach where resident abilities are limited and care is being provided. However, the suitability of the ADB guidance in terms of the numbers of bedrooms within a protected area and vertical means of escape should be tested to ensure a robust approach to evacuation, which considers the risk level of residents and how the buildings are currently managed and staffed.

9.2.4. The collated evidence has also shown that escape routes and the provision of supporting design and technology solutions need to be considered as to whether they would improve both the evacuation efficiency and the safety of residents during that process. We therefore recommend that the next stage of research includes a review of the effectiveness of the current provisions as set out, in terms of priority, below;

9.2.5. Care Homes (typologies 4 & 5):

1. Horizontal movement/escape – maximum number of bedrooms and size of protected areas and the escape distances between these.
2. Compartmentation – does guidance need to be improved and could supporting systems, such as smoke control, provide a more robust and flexible approach?
3. Vertical movement/rescue – number of stairs, evacuation lifts and refuges.

9.2.6. Specialised housing typologies (typologies 1, 2 and 3):

1. Vertical movement/escape – number of stairs, evacuation lifts and refuges.
2. Provision of measures which facilitate the possibility of phased evacuation as well as standard stay put policy.
3. Use of open plan dwellings in the housing models.
4. Compartmentation, does guidance need to be improved and could supporting systems, such as smoke extract, provide a more robust and flexible approach?

9.2.7. It is anticipated that the research into Purpose Groups for specialised housing typologies (typologies 1, 2 and 3) would further clarify evacuation issues around these typologies and is therefore not considered a priority if risks around these typologies are further researched.

9.3. Sprinklers

9.3.1. The stage 1a scoping work has determined that a number of countries, including Scotland and Wales require sprinklers to be installed in new specialised housing and care home buildings. The available research shows that sprinklers can significantly minimise temperatures beyond the room in which the fire originates as well as greatly improve visibility levels in the adjacent apartments and communal corridor, thus enabling residents to escape more easily and in reduced timescales. The collected evidence shows that sprinklers provide a cost-effective benefit in enabling evacuation of residents who have reduced mobility or require assistance, as well as minimising the impact of the fire on residents outside the room of origin. Additionally, sprinklers are also considered cost-effective when considering property protection and business interruption.

9.3.2. ADB requires sprinklers to be installed in buildings with a floor level over 11m, and the majority of new buildings in this sector are under that height threshold. It is recommended that stage 2 of the project should include further research the provision of sprinkler systems in buildings, of all heights and types, in the specialised housing and care home sector.

9.4. Mobility Scooters

9.4.1. The available research highlighted the need to consider the safe storage of mobility scooters to avoid risk to life due to rapid increase of heat and release of toxic fumes in the event of a fire. The stage 1a outline case studies found that where mobility scooters are most commonly used i.e. in specialised housing typologies 1 and 2, dedicated stores were mainly provided.

9.4.2. ADB is currently silent on the safe storage of mobility scooters. It is recommended that stage 2 of the research consider the safe storage of mobility scooters in terms of level of provision, but also the design of and technical specification of mobility scooter storage, both within individual dwellings and communal/ development wide facilities.

9.5. Prevention of External Fire Spread

9.5.1. The evidence shows that the majority of residents in specialised housing and care home buildings who can escape unaided will have extended escape times from the building due to their walking speeds. These times are very likely to be further impacted by the behaviour of residents and the physical conditions of a fire situation. However, no research was found which has modelled such extended escape scenarios to establish their impact in an external façade fire situation. As evidenced in this report, the majority of specialist housing and care home sector buildings are below 11m in height which means that they are not covered by the current regulation covering the ban of using combustible materials in facades. The emerging Part L and Future Homes and Buildings Standards may also influence the greater use of combustible insulants in the facades of buildings below 11m, thereby adding a greater risk.

9.5.2. The international research in section 7 of this report has shown examples where the fire performance requirements are specifically more demanding for specialised housing use classes.

9.5.3. As there is no available research on the impact of external fire spread on the ability residents of residents to escape in specialised housing and care homes, the guidance in ADB on external fire spread is likely to not have been developed considering these risks. We therefore recommend that further research into whether trigger heights should be lowered for specialist housing and care homes is considered.

10. Objective 2

10.1 Introduction

10.1.1 The Department for Levelling Up, Housing and Communities (DLUHC) commissioned PRP to assess the current provisions in Approved Document B (ADB) regarding specialised housing and care homes.

10.1.2 Based on the findings of Objective 1, a series of recommendations were put forward as outlined in the previous chapter and discussed within the project's Technical Steering Group.

10.1.3 DLUHC reviewed the recommendations, along with the Building Regulations Advisory Committee (BRAC) Fire Safety Working Group, and instructed the research focus for the next stage of work.

10.2 Objective 2 Instructions

10.2.1 Objective 2 research was defined by DLUHC within two independent instructions, namely;

Instruction 1

Further research specialised housing types, generating information on risk across building typologies. Review the effectiveness of different strategy options to address the established risks.

Instruction 2

Research the benefit of protected storage for mobility scooters

10.2.2. The research methodologies and findings for each of these instructions are set out separately within the subsequent chapters.

11. Objective 2: Instruction 1

11.1. Task

Under Objective 2, DLUHC instructed the completion of the following tasks:

i. Further research specialised housing types, generating information on risk across building typologies.

ii. Review the effectiveness of different strategy options to address the established risks.

Research Instruction 1 was only partially completed within the scope of this project. Task ii was not undertaken as part of the contracted work and has been identified as an area for future research. During the course of the project, the research aims were refined to focus on priorities that could be addressed within the project's scope. Consequently, certain aspects—such as smoke modelling or evaluating the implications of sprinklers under various scenarios—were identified as areas better suited for future investigation and have been included as recommendations for further research

11.2. Objectives

11.2.1. To satisfy the two tasks the following objectives were set:

1. To identify and evaluate the available evidence regarding the effectiveness of fire safety measures within specialised housing typologies, designed in accordance with the requirements of the Building Regulations 2010 and current ADB (Approved Document B) guidance.
2. To compare and evaluate the available evidence on the effectiveness of ADB guidance specialised housing typologies, in relation to the guidance given to residential non-specialised housing typologies.
3. Where there is a difference in the measured effectiveness of ADB guidance:
   a. Identify the potential cause for the difference
   b. Discuss whether the differences between the typologies could still result in buildings that are compliant with the Building Regulations 2010
   c. Identify design opportunities that could be considered which have the potential to minimise the difference

11.3. Methodology

11.3.1. The research will adopt the following two methodologies:

- **Review of Quantified and Qualitative Research on Residential Fires and Older Persons, and**
- **Review of UK Fire Statistics**

11.3.2. The Review of Quantified Research on Residential Fires and Older Persons will involve an extension to the literature review in Appendix 5. It will summarise the existing knowledge on the statistics related to the fire risks for older persons.

11.3.3. This Review will also provide an overview of supplementary qualitative research conducted by other researchers, illustrating the broader research landscape and its potential contributions to future research advancement.

11.3.4. The Review of UK Fire Statistics has four Areas of Investigation:

Investigation Area 1: Is there any statistical correlation that would indicate that fire spread is more extensive in Relevant Dwelling Types with one or more older occupants, than Relevant Property Types (terms as defined in Section 11.4.9).

Investigation Area 2: Is there any statistical indication that older 'Household occupancy types' have been rescued more times when compared to younger occupancy types, in particular in relation to Relevant Dwelling Types and Relevant Property Types.

Investigation Area 3: Is there any statistical indication that the presence of a working fire alarm system correlates to a decrease in the recorded number of fire-related casualties, or fatalities, in older occupancy age groups in Relevant Dwelling Types and Relevant Property Types.

Investigation Area 4: Is there any statistical indication that older occupancy types in Relevant Dwelling Types and Relevant Property Types have attempted an evacuation which has resulted in having to be rescued by fire service personnel.

11.3.5. The Review will primarily utilise statistical regression analysis to examine the impact and relationship between the dependent and independent variables of fire and rescue incident statistics.[66] These statistics will be derived from incident level datasets obtained from the Fire and Rescue Service's Incident Recording System (IRS)[67]. The IRS collects pre-defined information on each incident attended, the incident data is then published by the Home Office.

11.3.6. The following government datasets[68] published by the Home Office are used in the review:

Dwelling Fires Dataset (August 2021)
Other Buildings Fires Dataset (August 2021)[69]
Casualties in Fires Dataset (September 2021)
Fire-related fatalities Dataset (September 2021)

11.3.7. These datasets include data for the years 2010 to 2021. The financial years 2010/11, 2014/15 and 2020/21 are included to highlight any potentially significant temporal trends. They are also periods where there were not any significant amendments to the guidance for functional Requirements B1, B2 and B3.

11.4. Statistical Constraints

11.4.1. The review of past statistics to indicate future fire risk can form a valid part of the discussion and evidence base. However,

"The determination of the likelihood/ frequency/probability of an event is a balance between objectivism and subjectivism and the acceptance to a tolerable level of uncertainty. Particular difficulty can be experienced with high-consequence fire events as they are relatively rare and data can be somewhat limited. In addition, the nature of fire hazards over time (e.g., by reconfiguring buildings, changing contents); and the material composition of building products and contents changes makes even technical literature on the matter state that the ability to predict future hazards or risks is challenging at best"[70]

Where:

11.4.2. Likelihood refers to the possibility of an event occurring. It represents the subjective judgment or perception of the probability of an event happening. Likelihood is often expressed using qualitative terms such as "high," "medium," or "low," or using a scale of values (e.g., 1 to 5) to indicate the level of likelihood.

11.4.3. Frequency refers to how often an event occurs within a specific time period or sample. It is a measure of the rate of occurrence or occurrence over time. Frequency is usually expressed

66 *Home Office (HM Government, 2013). Retrieved from Fire and rescue incident statistics: https://www.gov.uk/government/collections/fire-statistics-monitor*
67 *Home Office (HM Government, 2021). Official Statistics, Fire statistics incident level datasets. Retrieved from GOV.UK: https://www.gov.uk/government/statistics/fire-statistics-incident-level-datasets*
68 *https://www.gov.uk/government/statistics/fire-statistics-incident-level-datasets*
69 *The other building fires dataset covers incidents attended by FRSs that were primarily fires in buildings other than dwellings in England.*
70 *Meacham, et al., Chapter 75 Building Fire Risk Analysis, SPFE Handbook, Fifth Edition (SPFE, 2016).*

numerically, such as the number of times an event occurs per unit of time (e.g., per year, per month).

11.4.4. Probability represents the mathematical measure of the likelihood of an event occurring. It is expressed as a number between 0 and 1, where 0 represents impossibility (the event will not occur) and 1 represents certainty (the event will definitely occur). Probability is often determined through mathematical calculations or statistical analysis based on historical data, observations, or theoretical models.

11.4.5. This Review aims to provide context for analysis and evaluations rather than stating predictions on the future likelihood, frequency, or probability of fires within specialist housing typologies.

11.4.6. Within the Dwelling Fires Dataset, there is no Dwelling Type category that aligns to:

- Housing with care (typology 2),
- Supported housing type 1 (typology 3)
- Supported housing type 2 (typology 4).

Therefore, direct comparison is not possible. In the Other Building Fires Dataset there are Property Type categories that provide accommodation and some health care capacity.

11.4.7. Property Types 'Nursing Care Home', 'Retirement Care Home' and 'Sheltered Housing' (Not self-contained) will be used as they appear to have comparable characteristics. Further information can be seen in the table**Error! Reference source not found.** below:

Table 3: Description of Property Types: with supporting information

Property Type	Current IRS Guidance	Other information
Nursing Care Home	-	Care homes provide accommodation and personal care for people who need extra support, e.g. help with eating, washing, dressing etc, Nursing homes have qualified nurses and care assistants to provide nursing care in addition to residential care.
Retirement Care Home	Old person's rest home. Does not include where the primary purpose is medical care.	-
Other Residential Home	-	A residential home not covered by the other categories of 'residential home'.
Sheltered Housing (Not self-contained).	This category should be very rarely used as most properties can be categorised elsewhere.	An example would be an 'assisted living' house where 4 or 5 people are living together with a carer in rooms within one property.

11.4.8. These three Property Types will be referred to as Relevant Property Types.

11.4.9. The following Dwellings Types are included in this Review.

- Bungalows,
- Purpose Built Low Rise (1-3) Flats/Maisonettes
- Other Dwelling Types

These Dwelling Types will be referred to as Relevant Dwelling Types.

11.4.10. Bungalows were selected to act as benchmark of independent living. There is evidence[71] that shows older households were far more likely to live in detached homes (22%) and bungalows (16%) compared with younger households, and far less likely to live in terraced homes or flats. Also, bungalows were judged to present characteristics more comparable to the accommodation that may be provided within the Specialised Housing Typologies.

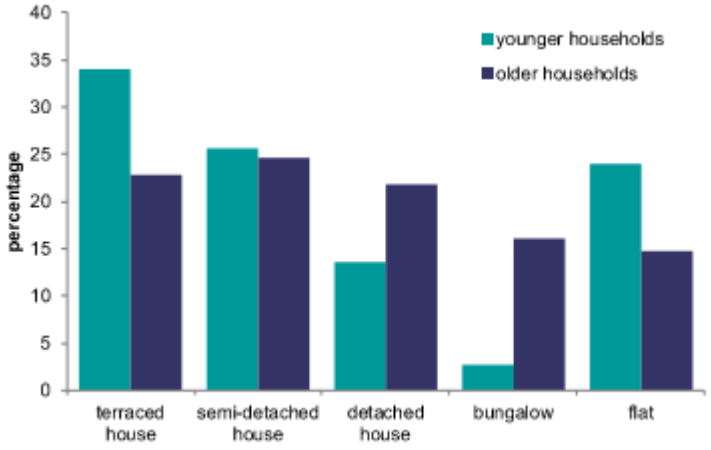

Figure 29: From (Department for Communities and Local Government, 2016)*: Figure 2.1: Dwelling type, younger and older households, 2014*

11.4.11. Purpose Built Low Rise (1-3) Flats/Maisonettes was selected as it is the Dwelling Type which closely aligned to Supported Housing Type 2 (Specialised housing Typology 4 as they tend to comprise 8-12 apartments which would roughly equate to 1-3 storeys.

11.4.12. The Dwelling Type 'Other Dwellings' Supported Housing Type 1 (Supported Housing Type 3). This data field also includes Caravan/mobile homes and Houseboats (amongst others). Therefore, to remove the influence of this types of properties only those properties that also have a mains-powered fire alarm will be used.

11.4.13. The Property Types do not relate to dwellings; Property Type and Dwelling Type are not the same data field and are not from the same dataset. A summary is given in the table below:

Relevant Property Types	**Relevant Dwelling Types**
Property Type	**Dwelling Type**
Nursing Care Home	Bungalows,
Retirement Care Home	Purpose Built Low Rise (1-3) Flats/Maisonettes, and
Other Residential Home	Other Dwelling Types
Sheltered Housing (Not self-contained).	

11.5. Data Quality Management

11.5.1. To ensure the data integrity, the datasets from dwellings and other buildings have not been combined.

71 *HM Government, English Housing Survey Housing for Older People Report, 2014-15 (Ministry of Housing, Communities & Local Government, 2006).*

11.5.2. Also, it was not possible to accurately and reliably combine the 'Casualties in Fires' dataset and the 'Fire-related Fatalities' dataset with either the 'Dwelling fires' dataset or 'Other Buildings fires' dataset. This is because the datasets are thematically unlinked as part of the data anonymisation process the Home Office has taken to ensure that the risk of identifying individuals and releasing personal or sensitive data is minimised.

11.6. Statistics Nominal Terms

11.6.1. The following information is presented to assist the reader with terms used with the Review of UK Fire Statistics Section.

11.6.2. A fire-related fatality is defined by the Home Office[72] as those that would not have otherwise occurred had there not been a fire. Fire-related fatalities includes those who died later, for example in hospital, from injuries related to the fire. Fire-related fatalities include natural causes of death, such as heart attacks, which were brought on by the fire. However, this does not include, for example, a suicide from exhaust fumes where the car later caught fire.

11.6.3. Non-fatal casualties in fires are those that fit into one of four sub-categories:

- Hospital severe – at least an overnight stay in hospital as an in-patient.
- Hospital slight – attending hospital as an outpatient (not a precautionary check).
- First aid given – first aid given at scene (by anyone), including after a precautionary check.
- Precautionary check – a precautionary check (to attend hospital or to see a doctor) was recommended (by anyone).

11.6.4. Dwelling is defined by the Home Office as "a property that is a place of residence i.e. occupied by households". The definition includes residential homes, sheltered accommodation, caravans, houseboats and Houses of Multiple Occupancy (HMO) but it does not include hostels, hotels and residential institutions, bed and breakfast establishments, nursing/care homes and student halls of residence which are defined as within "other buildings". Fires in common areas of flats (such as stairs) are defined as within "dwellings".

11.6.5. The Office of National statistics[73] stated that a dwelling is a unit of accommodation which may comprise one or more household spaces (a household space is the accommodation used or available for use by an individual household). A dwelling may be classified as shared or unshared.

11.6.6. A dwelling is shared if:

- The household spaces it contains have the accommodation type "part of a converted or shared house".
- Not all of the rooms (including kitchen, bathroom and toilet, if any) are behind a door that only that household can use.
- There is at least one other such household space at the same address with which it can be combined to form the shared dwelling.

Dwellings that do not meet these conditions are unshared dwellings.

11.6.7. The spread of fire is defined as the extent of flame and heat damage only at the fire's stop. This does not include smoke or other damage, such as water damage. The spread of fire is categorised as follows:

- Limited to item 1st ignited;
- Limited to room of origin;

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72 Home Office (HM Government, 2021). Official Statistics, Fire statistics incident level datasets. Retrieved from GOV.UK: https://www.gov.uk/government/statistics/fire-statistics-incident-level-datasets

73 Office for National statistics, 2011 Census User Guidance Glossary of Terms (Office for National statistics, 2014).

- Limited to floor of origin;
- Limited to 2 floors;
- Affecting more than 2 floors;
- Whole building;
- Roofs and spaces; and
- No fire damage.

11.6.8. A rescue is defined as:

A rescue is where a person has received physical assistance to get clear of the area involved in the incident. A baby carried out in the course of another person's escape is not included as a rescue, however if a rescuer (including FRS personnel) entered the building or other area affected by the fire in order to rescue the baby, then the baby is recorded as a rescue. A removal of a fatality is not recorded as a rescue, except where a rescue took place in circumstances which might have resulted in a life being saved, even if the person did not survive the rescue attempt.

The categories for Age of Victim are expressed in the following age ranges:

- Unspecified
- Under 1
- 1 to 5
- 6 to 10
- 11 to 16
- 17 to 24
- 25 to 39
- 40 to 54
- 55 to 64
- 65 to79
- 80 or over

Under 1, 1 to 5, 6 to 10, 11 to 16 years of age will be considered children.

Between and including the ages 17 to 64 will be considered adults under the pensionable age.

Those aged 65 years and above will be considered older persons and over the pensionable age

11.7. Review of Quantified and Qualitative Research on Residential Fires and Older Persons:

11.7.1. It is commonly understood that older persons are at increased risk from fire. This Review of Quantified Research on Residential Fires and Older Persons will involve:

- An extension to the literature review in Appendix 5 to summarize the existing knowledge on the statistics fire risks for older persons.
- Provide an overview of supplementary qualitative research conducted by other researchers, illustrating the broader research landscape and its potential contributions to future research advancement.

The Literature Review in Appendix 5 had the following relevant headings:

- Review fire safety guidance documents applicable to specialist housing and care homes
- Collate evidence from PRP's existing library and from other publications
- Occupant Characteristics and Fire Safety Systems

It had no objective to investigate quantified data on the fire risks for older persons.

This Review will form a narrative on the findings of available quantified research to determine:

- If older persons suffer more significant consequences from fire events, and if so, why?

- If older persons are subject to increased likelihood of causing or being involved in a fire event, and if so, why?

After which, the narrative will continue to discuss research findings which add to the conversation of risk factors for older persons

11.7.2. Official fire incident data was scrutinised by Hodkinson[74] as part of the ongoing discussions regarding high-rise residential safety and evacuation planning. The research reiterated that the evidence indicates a long-term downward trajectory in recent decades in residential fire risk. While not directly related to specialised housing, it provided some relevant conclusions about older persons, namely that:

"While older people are understandably more prone to death or injury, they are not benefiting from the same proportional decline in the likelihood of serious harm from falling fires and death/injury rates…

The older you are, the more likely you are to die in a domestic fire: in 2019/20, 65 to 79 year olds experienced 8.4 fatalities per million, rising to 16.9 per million for those 80 years and over, compared to below 5 fatalities per million population for those 54 and under…

When age and gender are combined, the disparities are even starker: for people aged 65 to 79, the fatality rate was 10.6 per million for men, and 6.4 per million for women; and for those 80 and over, the equivalent rates were 22.6 per million and 13.1 per million."

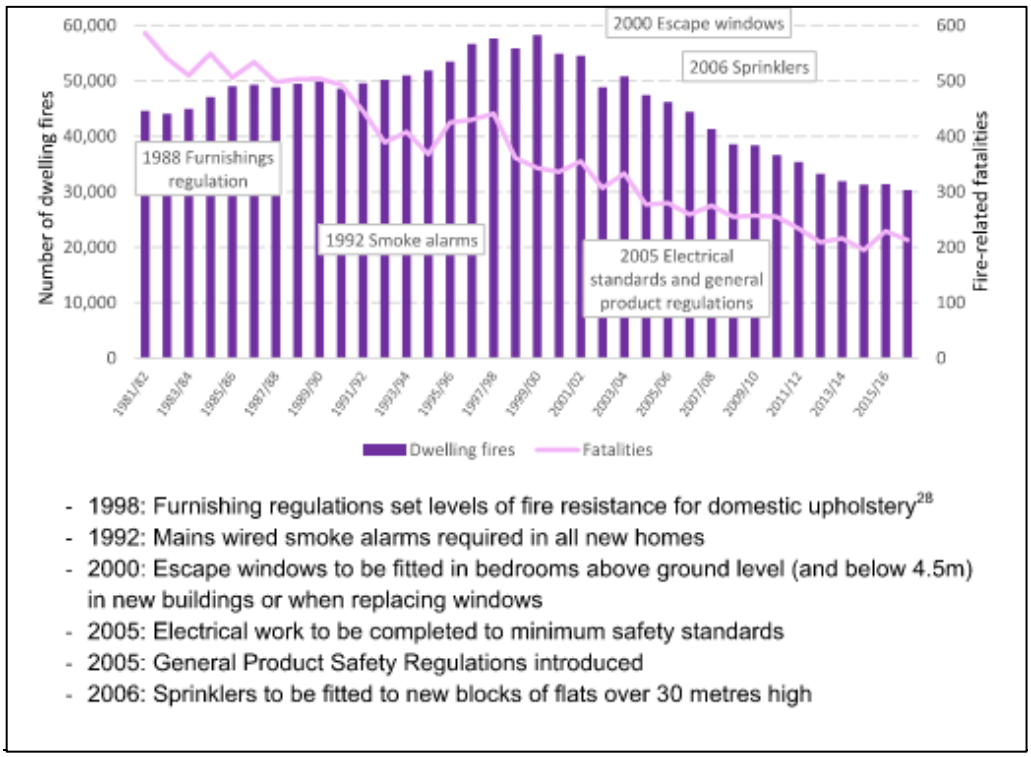

Figure 30: Taken from (S. Hodkinson, 2021): Figure 12: Dwelling fires and fire-related fatalities, shown against regulations aimed to increase fire safety, IRS, England; 1981-82 to 2016/17

11.7.3. The findings from Hodkinson were commented on by M. J Taylor [75] who concluded that evidence

74 *Hodkinson, et al., The Fire Risks of Purpose-Built Blocks of Flats: an Exploration of Official Fire Incident Data in England. Interim Research Findings. (British Automatic Fire Sprinkler Association, 2021).*

75 *Taylor, An Exploration of Causal Factors in Unintentional Dwelling Fires. Risk Management 14, no. 2, 109–125. (Springer, 2012).*

…suggests "*that it is the most vulnerable members of society, the old, the sick and disabled, and those suffering from mental illness or alcohol problems are the most at risk of unintentional dwelling fires*."

In addition, that report also concluded that

"*Mental health, disability and living alone were the most statistically significant factors for unintentional dwelling fire fatalities … additional factors including smoking and binge drinking were also significant."*

The Department for Communities and Local Government, 2006[76] noted that for England and Wales:

"Age-related impairment is a significant factor in the risk of a fatal fire occurring, with 39% of fatal fires within the sample involving age-related impairments (35% elderly; 4% young infant)…

The majority of fatal fires involved those over the age of 80 years (19%), with 63% of fatal fires involving people over 50% …

Those between 70 and 80 are twice as likely to be killed in a house fire then we would expect given their prevalence within the general population (16% compared with 7%), with those over 80 nearly five times more likely to be killed in a house fire than would be expected (19% compared with 4%) given the current age-profile of the population."

11.7.4. The Home Office[77] also suggested that households who had respondents under the age of 60 were more likely to experience a fire than those with a respondent over 60; this includes minor fires when there was no need for the fire rescue service to attend. This indicates that those dwellings, with an occupant under the age of 60, are more likely to experience a fire. The fires in dwellings with an occupant over the age of 70 are statistically more likely to result in a fire-related fatality.

11.7.5. The Dutch Burns Foundation, Institute for Safety[78] provided some clarification to the conversation by stating that:

"... it is not the case that all age-related ailments contribute to the same degree to an increased chance of becoming a burns victim. Literature mainly refers to a diminished functioning of the senses as being an important risk factor, such as loss of hearing and loss of vision (particularly a risk on evacuation), but also loss of smell and deterioration of the sense of touch (the elderly have a reduced sensitivity to pain, which is perhaps why they notice heat less quickly).

… the elderly will react less rapidly when there's fire and the survival time in a domestic fire has reduced in the course of time, a rapid reaction time is essential for the chance of survival.

As a consequence of age-related ailments or physical impairments, there is often also a reduced mobility. Due to a reduced mobility, the elderly are less able to evacuate the home in case of fire. Especially in combination with a delayed reaction time, the chance of a fatal domestic fire is significantly increased with reduced mobility. Also, disorders relating to breathing and cardiovascular disorders qualify as risk-increasing. In both disorders, the physical condition is reduced which causes people to be vulnerable"

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76 HM Government, Learning Lessons from Real Fires: Findings from Fatal Fire Investigation Reports. (Department for Communities and Local Government, 2006).

77 Bryant and Preston, Focus on trends in fires and fire-related (Home Office, 2017).

78 Dutch Burns Foundation, Fire safety and the ageing population (Netherlands Institure for Public Safety, 2016).

Harpur, et al. [79] stated that:

"Existing research on the subject indicates that the reasons why the elderly are vulnerable are multiple, interlinked and can vary greatly from one individual to another While age-related decline in health can vary dramatically from person to person, it is generally accepted that the fire risk to the elderly increases with age, with those over 85 years understood as those most at risk".

The Dutch Burns Foundation, Institute for Safety, stated that "*It is a statistical given that people with a lower socio-economic status more often fall victim to fire, but that does not necessarily mean that the socio-economic status is the cause of this. Other factors also possibly play a role, for example, that people with a lower socio-economic status more often live in housing that is less fire safe."*

Given the higher probability that they will be living in a property that is less fire safe leads to a higher risk. It follows that the lower socio-economic status is a cause.

Runefors, et al., [80] also stated that *"the risk groups, at least in most western countries, are elderly, the disabled and people suffering from substance abuse".*

11.8. It can be seen from the information above that Older persons are:

- More likely to be injured or killed in a fire mainly due to age related impairments and increased vulnerability from social and economic factors
- But there is no indication that older persons (in dwellings) are causing more fires due to either their age related impairments or from social and economic factors than other demographics

11.8.1. This research indicates that the effect of the combination of risk factors, that places an older person at a higher risk from a fire event, is not just related to the built environment.

11.8.2. Dutch Burns Foundation, Institute for Safety, set out in Figure 31 what can and cannot be influenced.

79 Harpur, et al., An Investigation into the Circumstances Surrounding Elderly Dwelling Fire Fatalities and the Barriers to Implementing Fire Safety Strategies among this Group . Fire Safety Science-Proceedings Of The Eleventh International Symposium, (pp. 1144-1159). (Ulster University, 2014).

80 Runefors et al., The effectiveness of specific fire prevention measures for different population groups. Fire Safety Journal 91, 1044-1050. (Lund University, 2017).

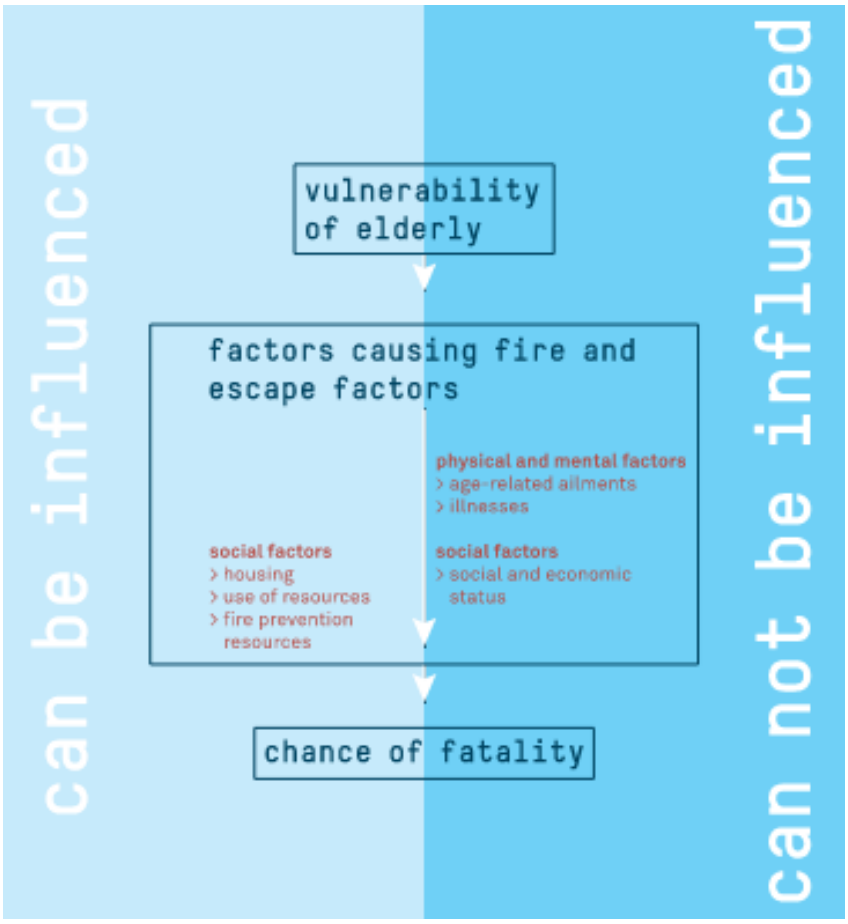

Figure 31: From Dutch Burns Foundation, Institute for Safety, 2016: Figure 2.1 Risk Factors

11.8.3. The type of housing is designated as something that can be influenced, which provides an opportunity to examine the significance of the housing and specialist housing design.

11.8.4. However, can one examine the influence of a home's design in a way that directly correlates to securing a reasonable standard of health and safety for persons in or around a building? Thompson, et al.,[81] in their literature review set out a "*key factor that underpins the differences between behaviour in fires: Closed versus open building systems"* as defined by Shields & Proulx,[82] a closed building is one where activities are formalised and managed, and processes are controlled. Such closed building systems manifest themselves through the presence of regulation (both prescriptive and performance-based), and identifiable, often hierarchical management structures. A dwelling is an open-building system; there is no formalised management structure relating to the building and how it is used, including the absence of any roles prescribed by fire safety regulations.

11.8.5. The literature review stated that:

It *"was clear that the greatly different environmental, physical and social circumstances that are present in dwelling fires compared to fires in closed building spaces means that knowledge relating to human behaviour in the latter cannot be assumed to be applicable to the former".*

11.8.6. The review also commented that:

The gaps *"in the knowledge of behaviour in dwelling fires has only been partially filled to date as the work that has dealt with domestic environments has been dominated by a focus upon identifying the occupant and environmental risk factors there has begun to be a greater*

81 *Thompson, et al., A review of the literature on human behaviour in dwelling fires. (Safety Science, 303-312, 2018).*

82 *Shields and Proulx, The science of human behaviour: past research endeavours,current developments and fashioning a research agenda, (pp. 95-114).(Sixth International Symposium on Fire Safety Science, IAFSS, 2000).*

recognition of the distinction between the risk of having a fire, the risk of being injured and risk of dying".

11.8.7. A care home may be considered a closed building system. As with any health care facility, the evacuations are more complex with increased reliance on staff performance and fire safety management systems in place before a fire event. Rahouti, et al. [83] *"identified additional movement phases present in healthcare facility evacuations that are typically not present in non-healthcare facility evacuations".*

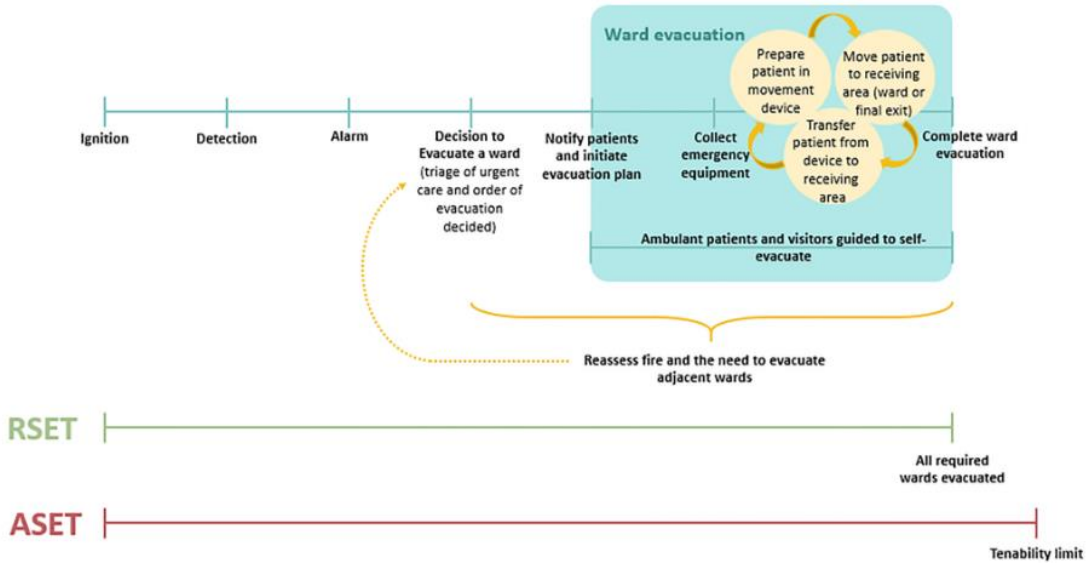

Figure 32: From Rahouti, et al., 2020: Figure 1 Schematic of the healthcare facility evacuation timeline (Required safe Egress Time (RSET) and Available Safe Egress Time (ASET)

11.8.8. It can be seen that the timeline for healthcare is more iterative, dynamic, and dependent on accurate and reliable information to support complex decision making on issues that include:

a) the particular requirements of patients,
b) the availability of evacuation equipment,
c) the application of procedural measures (e.g. detection, notification systems, etc.),
d) the availability of trained staff.

11.8.9. Compare this to the "traditional" Required safe escape time - RSET (the calculated time available between the ignition of a fire and the time at which occupants, in a specified space in a building, are able to reach a place of safety) paradigm as set out in against Available safe escape time - ASET (the calculated time available between the ignition of a fire and the time at which tenability criteria are exceeded, in a specified space in a building) as described in PD 7974-6 , 2019[84], which whilst requires suitable and appropriate attention, is more linear and consecutive.

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83 Rahouti, et al., Human behaviour during a healthcare facility evacuation drills: Investigation of pre-evacuation and travel phases (Safety Science, 129, 2020).

84 BSI, PD 79474-6: 2019 Application of fire safety engineering principles to fire safety design of buildings — Part 6: Human factors: Life safety strategies — Occupant evacuation, behaviour and condition (Sub-system 6) (BSI, 2019).

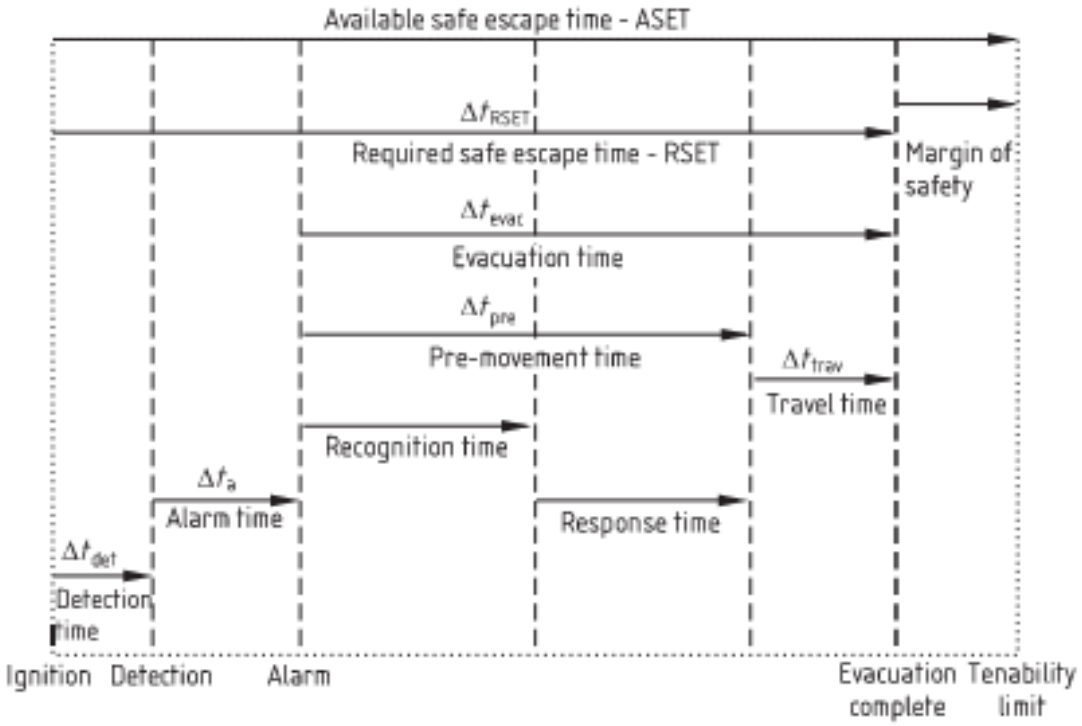

Figure 33: From PD 7974-6 , 2019 : Figure 1 - Simplified schematic of processes involved in escape time compared to available safe escape time.

11.8.10. In other areas of research, looking at the effectiveness of fire prevention, Coty, et al., [85] suggests that "*the presence of social support networks"* influenced the perceived fire risk, referring to the comments from many of their participants saying that *"if not for them [e.g., family church members], I do not know what I would do in case of a fire".* Harpur, Boyce, & Mc Connell, 2014[86], provided further commentary stating that:

> *"Additionally, considerable efforts had been invested by family, health and community workers into preventing these elderly persons becoming involved in fires. However, this was largely limited to preventing the actual fire, with comparatively fewer preparations being made to address how the elderly person would actually escape in the event of a fire…*
>
> *A somewhat surprising observation was with regard to the types of people who detected the fire risk; this varied from close relatives and neighbours to occasional visitors to the household, e.g. health and social care workers, community workers such as meals-on-wheels and even postal workers or delivery persons…*
>
> *Although risk was frequently acknowledged, many of those who had concerns about the safety of an elderly person were unable to take pro-active measures to address the risk. Some were unsure how to go about addressing the risk or felt that they did not want to offend the elderly person and it was not their place to intervene. Others did attempt to intervene, but the fatality was reluctant to adopt fire safety measures. According to relatives and associates, this was often underpinned by the at-risk person's concern that their independence would be undermined or, that by accepting help, they were admitting that they were unable to care for themselves".*

85 *Coty, et al., Home fire safety beliefs and practices in homes of urban older adults (Geriatric Nursing, 2015).*

86 *Harpur, et al., An Investigation into the Circumstances Surrounding Elderly Dwelling Fire Fatalities and the Barriers to Implementing Fire Safety Strategies among this Group. Fire Safety Science-Proceedings Of The Eleventh International Symposium, (pp. 1144-1159). (Ulster University, 2014).*

11.8.11. Other research by Runefors, et al.,[87] highlights the importance of acknowledging the difference in effectiveness of different measures for different occupancies, and for people living alone or not does imply causality but only correlation. It was citing an example where men aged between 50 and 84 benefitted significantly more from fire resistant furniture than other groups (more than double that of any other group). This is stated to be likely due to different habits, where it can be hypothesised that men have a higher tendency to sleep (and smoke) on the sofa compared to in bed.

11.9. Findings of the Review of Quantified and Qualitative Research on Residential Fires and Older Persons

11.9.1. The review has highlighted research which indicates the following risk factors, as an influence on the risk of harm from fire for an older person:

- Age related impairments, disability or underlying health problems
- Gender
- Living alone and the presence of staff, and social support networks
- Whether the residency is a closed or open building system together with the allocated resources
- Social and economic factors
- Life style choices
- Prevention activities

11.9.2. Some of those factors can be directly ratified to reduce the risk of harm from fire for an older person and some not so directly.

11.9.3. Different techniques would be needed to identify and evaluate the influence of those factors in dwellings (open building system) and part care facility (closed building system). This could result in the comparison of the influence of those risk factor types of system be to complex and detailed. Currently there is no research to which makes that harmonised comparison.

11.9.4. However, the research does draw some firm conclusions:

"Throughout the literature, it is clear that the risks associated with older adults are complex and characterised by many interlinking factors" Cassidy, et al.,[88].

Harpur, et al., also stated that:

"Implementing community fire safety strategies for the elderly is deeply complex as there are many variations, combinations and intensities of risk factors to overcome;"

11.9.5. Specialised housing typologies may present a combination of closed and open building characteristics. There is no published research which discusses or seeks to explain the risk factors for older persons in specialised housing typologies.

11.9.6. While this section referenced numerous research papers that offered valuable insights into relevant aspects of the discussion, no research was identified that specifically examined the role of passive fire safety measures in fire safety design or provided evidence of their effectiveness in reducing the risk of harm from fire for older persons in properties aligned with specialised housing typologies.

11.9.7. In conclusion, the Review of Quantified and Qualitative Research on Residential Fires and Older Persons has been unable to identify any evidence regarding the effectiveness of fire safety measures within specialised housing typologies designed in accordance with the requirements of the Building Regulations 2010 and current ADB (Approved Document B) guidance.

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87 Runefors, et al., The effectiveness of specific fire prevention measures for different population groups. Fire Safety Journal 91, 1044-1050 (Lund University, 2017).

88 Cassidy, et al.,The older adult: Associated fire risks and current challenges for the development of future fire safety intervention strategies. Interflam 2019: Human Behavior in Fire. (Ulster University, 2020).

11.9.8. The absence of evidence does not prove that fire safety measure in specialised housing typologies are, or are not, effective. There is no available evidence at the current moment to support or confirm one conclusion over the other.

11.9.9. This absence highlights the need for further investigation or exploration to obtain more evidence before reaching a definitive judgment.

11.10. Review of UK Fire Statistics

This has four Areas of Investigation in relation to Relevant Property Types (see section 11.4.9).

11.10.1. **Investigation Area 1:** Is there any statistical correlation that would indicate that fire spread is more extensive in Relevant Dwelling Types with one or more older occupants, then Relevant Property Types

11.10.2. **Investigation Area 2:** Is there any statistical indication that older 'Household occupancy types' have been rescued more times when compared to younger occupancy types, in particular in relation to Relevant Dwelling Types and Relevant Property Types.

11.10.3. **Investigation Area 3:** Is there any statistical indication that the presence of a working fire alarm system correlates to a decrease in the recorded number of fire-related casualties or fatalities in older occupancy age groups in Relevant Dwelling Types and Relevant Property Types.

11.10.4. **Investigation Area 4:** Is there any statistical indication that older occupancy types in Relevant Dwelling Types and Relevant Property Types have attempted an evacuation which has resulted in having to be rescued by fire service personnel.

11.10.5. This Review utilises statistical regression analysis to examine the impact and relationship between dependent variables and independent variables of fire and rescue incident statistics. These statistics are derived from incident level datasets obtained from the fire and rescue service's Incident Recording System (IRS). The IRS collects pre-defined information on each incident attended, by Fire and Rescue Services. The incident data is published by the Home Office.

11.10.6. Investigation Area 1: Is there any statistical correlation that would indicate that fire spread is more extensive in Relevant Dwelling Types with one or more older occupants, then Relevant Property Types

11.10.7. This Area of Investigation returns to the terms Relevant Property Type and Relevant Dwelling Type previously discussed. Table 4 (Parts a, b, c, d) sets out the extent of internal fire damage within Relevant Property Types and Relevant Dwelling Types as a function of age of the occupants over as set out by data from three yearly periods

11.10.8. The fire damage date field was selected to provide an indication of internal spread of smoke, not just the area of burning. This is judged to present the area in which could be considered hazardous.

11.10.9. The review of extent of fire damage could provide preliminary indication of performance that the following statements of intention form ADB.

11.10.10. There are sufficient means for giving early warning of fire to people in the building.

- Where necessary, escape routes are sufficiently protected from the effects of fire and smoke
- There are appropriate provisions to limit the ingress of smoke to the escape routes, or to restrict the spread of fire and remove smoke.
- The building fabric should make a limited contribution to fire growth, including a low rate of heat release.
- Compartmentation of buildings by fire resisting construction elements.

- Protection of openings in fire-separating elements to maintain continuity of the fire separation.
- Inhibition of the unseen spread of fire and smoke in cavities, in order to reduce the risk of structural failure and spread of fire and smoke, where they pose a threat to the safety of people in and around the building.

Table 4a: Extent of fire damage for Relevant Property Types as a function of the age of the occupancy

Relevant Property Type	2020/21		2014/15		2010/11	
	Data Field definition	Value	Data Field definition	Value	Data Field definition	Value
Sheltered Housing - not self-contained	≤5m² & No Dam	95%	≤5m² & No Dam	97.5%	≤5m² & No Dam	97.5%
	6-10 m²	3.5%	6-10 m²	2%	11-20 m²	1.5%
Nursing Care Home	≤5m² & No Dam	92.5%	≤5m² & No Dam	96%	≤5m² & No Dam	96%
	6-10 m²	4%	6-10 m²	2%	6-10 m²	2%
Retirement Home	≤5m² & No Dam	97.5%	≤5m² & No Dam	96.5%	≤5m² & No Dam	97.5%
	6-10 m²	1%	6-10 m²	1%	6-10 m²	1.5%

Table 4b: Extent of fire damage for Bungalows as a function of the age of the occupancy

Bungalows	2020/21		2014/15		2010/11	
	Data Field definition	Value	Data Field definition	Value	Data Field definition	Data Field definition
All occupancy types	≤5m2 & No Dam	88.5%	≤5m2 & No Dam	81.5%	≤5m2 & No Dam	81%
	6-10 m²	8%	6-10 m²	7.5%	6-10 m2	7%
Lone person over pensionable age	≤5m2 & No Dam	87%	≤5m2 & No Dam	87.5%	≤5m2 & No Dam	86%
	6-10 m²	6%	6-10 m²	5%	6-10 m²	6%
Couple one or more over pensionable age, no child	≤5m2 & No Dam	76%	≤5m2 & No Dam	73.5%	≤5m2 & No Dam	82.5%
	6-10 m²	12%	6-10 m²	12%	6-10 m²	6%

Table 4c: Extent of fire damage for Purpose Built Low Rise (1-3) Flat/Maisonette as a function of the age of the occupancy

Purpose Built Low Rise (1-3) Flat/Maisonette	2020/21		2014/15		2010/11	
	Data Field definition	Value	Data Field definition	Value	Data Field definition	Value
All occupancy types	≤5m² & No Dam	88.5%	≤5m² & No Dam	89%	≤5m² & No Dam	89.5%
	6-10 m²	5.5%	6-10 m²	5.5%	6-10 m²	6%
Lone person over pensionable age	≤5m² & No Dam	92.5%	≤5m² & No Dam	93.5%	≤5m² & No Dam	93.5%
	6-10 m²	4.5%	6-10 m²	3%	6-10 m²	3%
Couple one or more over pensionable age, no child	≤5m² & No Dam	84%	≤5m² & No Dam	96%	≤5m² & No Dam	94.5%
	6-10 m²	10%	11-20 m²	2%	6-10 m²	2.5%

*Table 4d: Extent of fire damage for **Other Dwelling Types** as a function of the age of the occupancy*

Other Dwelling Types	2020/21		2014/15		2010/11	2010/11
	Data Field definition	Value	Data Field definition	Value	Data Field definition	Value
All occupancy types	≤5m² & No Dam	94.5%	≤5m² & No Dam	95%	≤5m² & No Dam	95.5%
	6-10 m²	3%	6-10 m²	3%	6-10 m²	2%
Lone person over pensionable age	≤5m² & No Dam	95.5%	≤5m² & No Dam	96%	≤5m² & No Dam	96.5%
	6-10 m²	3%	6-10 m²	2.5%	6-10 m²	2.5%
Couple one or more over pensionable age, no child	≤5m² & No Dam	93%	≤5m² & No Dam	96%	≤5m² & No Dam	96%
	51-100 m²	3%	6-10 m²	3%	6-10 m²	2%

11.11. Investigation Area 1: Findings

These findings are based on the data set out in Table 4a, 4b 4c, 4d in relation to Relevant Property Types (see section 11.4.9).

11.11.1. In all Relevant Property Type and Relevant Dwelling Type over the three financial year periods the significant majority of fires cause 'no damage' or 'damage which was limited to 5m^2'. This is broadly consistent with recent data from the Home Office, 2019[89] that stated *in 2018/19, nearly one third (30%) of* [all] *dwelling fires had no fire damage, in just under a third (32%) the damage was limited to the item first ignited and a quarter (25%) the damage was limited to the room of origin.* The remaining 18% of all dwelling fires could not be characterised by those classifications.

11.11.2. In the Home Office's fire statistics, the term "no fire damage" refers to incidents where a fire occurred but did not cause any damage to property, structures, or contents. This classification indicates that the fire was either contained promptly or did not develop to a stage where it inflicted physical damage. It's important to note that while there may be no fire damage, other forms of impact, such as smoke or heat damage, could still be present

11.11.3. It can be seen from Table 4a, that Retirement Homes across all years have the largest average percentage of fires that caused 'no damage' or 'damage which is limited to 5m^2' at 97.1%.

11.11.4. It can be seen from Table 4b, Bungalows (Couple one or more over pensionable age, no child) demonstrate on average, across all years, the lowest percentage of fires that cause 'no damage' or 'damage which is limited to 5m^2' at 77.2%.

11.11.5. Bungalows (all occupancy types) record on average across all years the lowest percentage of fires that cause 'no damage' or 'damage which is limited to 5m^2' within the Relevant Dwelling Types at 84%.

11.11.6. On average for all the list financial years, the percentage of fires that cause 'no damage' or 'damage which is limited to 5m^2' is greatest for the Relevant Property Type properties. Nursing/care homes, which are likely to be staffed properties, and could be considered similar to Houses with Care or Care home specialised housing typologies, comparatively has the lowest percentage within the Relevant Property Type grouping at 94.6%. This is a value comparable with the Other Dwelling Type at 95%. It is reasonable to expect that Relevant Property Type would record a lesser amount of fire damage due to being closed building system type properties.

11.11.7. Within the Relevant Dwelling Types with couples and lone persons over pensionable age, in purpose built low rise (1-3) Flat/Maisonette (Tables 4b and c) indicate a distinct decrease in the percentage of fires that cause no damage or damage which is limited to 5m^2.

11.11.8. Notwithstanding the above, within Relevant Dwelling Types, there is no clear or significant difference in the percentage of fires that cause 'no damage' or 'damage, which is limited to 5m^2' between older occupancy types.

11.11.9. There is no clear or significant difference in the extent of fire damage within Relevant Property Types.

11.11.10. Generally, from 2010/11 to 2020/21, excluding Bungalows, there has been a slight reduction of percentage of fires that cause 'no damage' or 'damage which is limited to 5m^2'.

11.11.11. Noting the fact that the Care Home specialised housing typology having been removed from further consideration. At this time there is no clear indication that there is significant difference of extent of fire damage across Relevant Property Type and Relevant Dwelling Type properties.

11.11.12. Therefore, from this review of UK Statistics there is no indication that the intention of the guidance as set out in ADB is resulting in buildings where an increase in fire damage is evident

89 *HM Government, Detailed analysis of fires attended by fire and rescue services, England, April 2018 to March 2019 (Home Office, 2019).*

11.12 Investigation Area 2: Is there any statistical indication that older 'Household occupancy types' have been rescued more times when compared to younger occupancy types, in particular in relation to Relevant Dwelling Types and Relevant Property Types.

11.12.1 This data item was selected to test the hypothesis that if there is an increase in the occurrence of rescues for older occupancy types in relevant Dwelling Types that may indicate a possible failure in fire strategies to provide an appropriate means of escape as set out in Regulation B1.

This data cannot provide information on:

- The actions and intentions of persons during the fire event,
- The fire ignition events or fire development,
- The effect of any latent building defects that would cause passive fire measures not to perform as intended, or
- The fire safety management policies and procedures that may have been in place.

11.12.2. If the statistics indicate there is an increase in occurrence of rescues for older occupancy types in relevant Dwelling Types, this may highlight an area for further research into any possible correlation and causation.

11.12.3. The Casualties in fires dataset set cannot be directly transferred to the data in the Dwelling Fires dataset and the other building fires dataset. For example, Age of Victim field from the Casualties in fires dataset can only be compared with Occupant Type data field from the Dwelling Fires dataset. There is no Age of Victim data set in the Dwelling Fires dataset. A direct comparison cannot be made

11.12.4. Children (from under 1 year old to 16 years old), Adults (17 years old to 64) and Older Persons (65 years old and over) will be used. The data for children is used to present another vulnerable occupancy for comparison. The Adult data set is used to act a baseline, for residents that would not have age related impairments or disadvantages.

11.13 Investigation Area 2: Findings

11.13.1 It can be seen in Figure 33, Figure 34 and Figure 35 that the proportion of rescues of persons, from accidental dwelling fires over 80 years old and between 65-79 years old has increased over the 10-year time period.

11.13.2 In the financial year 2020/2021 the percentage of the rescue of adults over 65 years by fire service personnel accounted for 34.36% compared to the percentage proportion of the rescue by fire service personnel of children of all ages (another risk group) at 6.42%. Discounting the 'Unspecified' group, the percentage proportion of the rescue by fire service personnel of adults between the ages of 17-64 account for 47.12%.

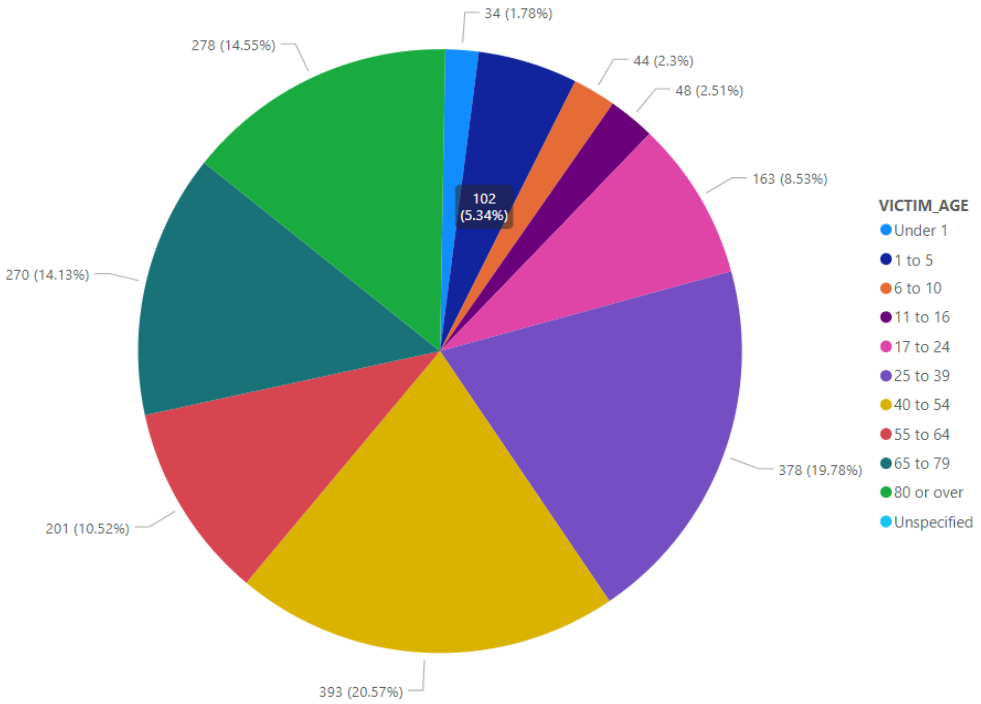

Figure 34: The number of accidental dwelling fires by the age of rescued victims, 2010/11

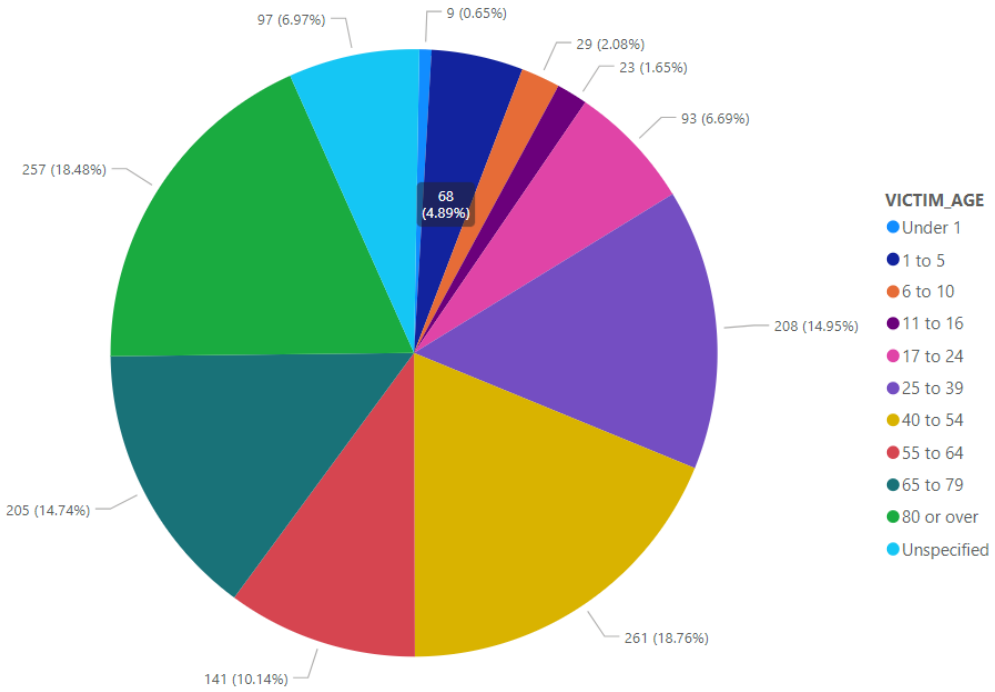

Figure 35 : The count of accidental dwelling fires by the age of rescued victims, 2014/15

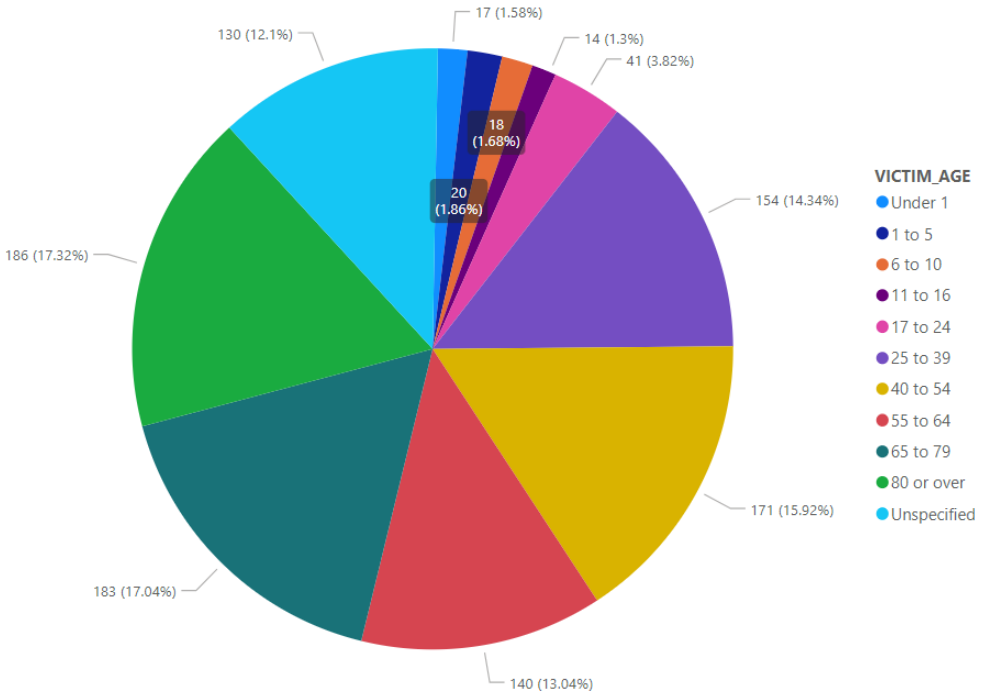

Figure 36: The count of accidental dwelling fires by the age of rescued victims, 2020/21

11.13.3 The trends indicated in the above Figures shows that while over the time period the there is a decreasing percentage proportion of rescues for all persons under the age of 65, with the most significant reduction in Children, for adults over 65, there is an increase in the percentage proportion of rescues. This can be seen visually in the moving dark green and red slices in Figure 34, Figure 35 and Figure 35.

Table 5: Percentage difference within different financial years of percentage proportion of rescue by fire service personnel in relation to age of victim in accidental dwelling fires

Financial year	Percentage of Rescued victims that were Children (0-16 years)		Percentage of Rescued victims that were Adults (17-64 years)		Percentage of Rescued victims that were Older Persons (65 and over)		Percentage of total accidental fires where the occupancy was over the pensionable age	
2010/2011	11.98%		59.4%		28.68%		21.68%	
2014/2015	9.27%	↓22.6%	50.54%	↓17.5%	33.22%	↑15.8%	22.34%	↑3%
2020/2021	6.42%.	↓44.4%	47.12%.	↓7.2%	34.36%	↑3.4%	22.46%	↑0.5%

11.13.4 As previously stated direct comparison between the victim age and occupancy type. However purely for indicative purposes it can be seen that that percentage difference between the three-year periods for the percentage of total accidental fires where the occupancy were the occupants were over the pensionable age is less that the percentage difference of percentage of Rescued victims that were Older Persons (65 and over) in the same year ranges.

11.13.5 As there has not been any significant changes in the guidance for Functional Requirement B1, B2 and B3 this may indicate that there are influences that are not yet identified. This area may benefit from further investigation.

11.13.6 The findings from the statistical Review can be contextualised research by Runefors, et al.,[90]that studied the incident report database, both maintained by the Swedish Civil Contingency Agency which

> *"indicated that fewer than half of their victims [*older adults, 65+] *(39%) evacuated independently and many rely on evacuation assisted by neighbours (18%), first-responders (27%) or homecare personnel (8%)".*

The report also concluded that "*Living in urban areas was found to increase the odds of survival. Based on the results from the analysis of evacuation, this is likely due to a combination of proximity to neighbours and a short response time".*

11.14 Investigation Area 3: Is there any statistical indication that the presence of a working fire alarm system correlates to a decrease in the recorded number of fire-related casualties or fatalities in older occupancy age groups in Relevant Dwelling Types and Relevant Property Types.

11.14.1 The inclusion of a working fire alarm in this Review was chosen to examine if there is a relationship between the presence of a functioning fire alarm and the rate of occurrence of fire-related fatalities or casualties within the Older Person age groups. The inference being that those fires with a fire alarm that performed as intended would result in a lower occurrence of fire related fatalities or casualties.

11.14.2 The review used the dwelling fires and the other building fires data sets with particular attention to the 'Did Alarm System Operate?' IRS Question**.** To enable a meaningful comparison with the Relevant Property Types all occupancy types were included as well as the occupancy types that include one or more older resident. Due to the data size and ease of presentation a single year period (2020/2021) was chosen.

11.14.3 The response to the IRS Question 'Did Alarm System Operate?' has the fields 'No', 'Yes but did not raise the alarm' and 'Yes and raised the alarm'.

11.14.4 If the 'No' or 'Yes but did not raise the alarm' field is selected then there is a subsequent data entry for the reasons for the 'poor outcomes'.

11.14.5 An analysis of the reasons for a 'poor outcome' (IRS Question 5.12) has not been undertaken.

11.14.6 For this investigation, IRS responses of 'No' or 'Yes but did not raise the alarm' have been classified as "the fire alarm system did not perform as intended" and are presented as such in Table 6. However, a response of 'Yes [the alarm system operated] but did not raise the alarm' does not necessarily indicate a system fault. It reflects cases where the fire was identified by other means before the alarm actuated, for example, where a person observed the fire directly.

11.14.7 It is recognised that a fire alarm, whether providing an audible or visual cue to the presence of a fire, it may not be the sole factor that prompts an occupant's response. Other cues, such as the observation of smoke (fire cues) or hearing individuals shouting (people cues), may serve as the primary or initial stimulus for action or movement. Furthermore, the type and intensity of cues can vary, and their correct interpretation may depend on individual circumstances. Older individuals may require multiple cues, additional information, or support with decision-making to initiate an appropriate response.

11.14.8 Just because a fire alarm system was present and 'raised the alarm', does not necessarily indicate that was how residents were alerted of the fire.

11.14.9 Therefore, the fact that a fire alarm 'but did not raise the alarm' does not necessarily mean the system was defective or ineffective.

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90 Runefors, et al., Factors contributing to survival and evacuation in residential fires involving older adults in Sweden. Fire Safety Journal 122. (Lund University, 2021).

11.15 Investigation Area 3 Findings

11.15.1 Below is a table which sets out the percentages of fires that recorded a casualty or fatality in relation to whether the building's fire alarm performed as intended. The data is taken from the other building and dwelling fire datasets

Table 6: Percentage of fire that recorded a fire-related casualty as a function of whether the building's fire alarm perform as intended.

Relevant Dwelling Type and Relevant Property Type.	Percentage of fires that did record a casualty or fatality and the fire alarm did performed as intended	Percentage of fires that did record a casualty or fatality and fire alarm systems did not perform as intended
Sheltered Housing - not self-contained	7.5%	4.5%
Nursing Care Home	9.2%	1%
Retirement Home	10.7%	12.1%
Bungalow	20.9%	15.1%
Other Dwelling Types	16.9%	18.4%
Purpose Built Low Rise (1-3) Flat/Maisonette	16%	20.8%

11.15.2 From Table 6, it can be observed that for Bungalows with an older population, 20.9% of fires resulted in a casualty or fatality when the fire alarm 'performed as intended', compared to 15.1% when no alarm was present or the alarm did not function as intended. This difference is only marginally statistically significant (P-value = 0.050), and is not strongly conclusive or draw any firm conclusion.

11.15.3 A statistically significant difference (P-value = 0.033) was recorded in Nursing Care Homes. The data indicates that only 1% of fires where the fire alarm systems did not perform as intended resulted in a casualty, compared to 9.2% of fires where the fire alarm 'operated as intended'.

11.15.4 These counterintuitive results suggest that factors not yet identified beyond alarm activation, such as fire prevention strategies, staff intervention, alternative fire cues, or evacuation procedures, may play a more decisive role in determining fire-related outcomes particularly in Nursing Care Homes and Bungalows. This is consistent with the Section 11.9 Findings of the Review of Quantified and Qualitative Research on Residential Fires and Older Persons discussed above.

11.15.5 Analysis of Table 6 indicates that the presence of a working fire alarm system does not consistently correlate with a reduction in fire-related casualties or fatalities across the dwelling types considered. In fact, in Nursing Care Homes and Bungalows, the proportion of fires resulting in casualties was higher where alarms operated as intended. This suggests that casualty outcomes are strongly influenced by other factors, including the characteristics and vulnerabilities of occupants, as well as management and evacuation arrangements, rather than by alarm operation alone.

11.15.6 Apart from Nursing Care Homes and Bungalows, there appears to be no statistically significant evidence that the presence of a working fire alarm system correlates with a significant decrease in recorded fire-related casualties or fatalities in older occupancy types across the Relevant Dwelling Types and other building Relevant Property Types.

11.15.7 This preliminary review cannot demonstrate that for Sheltered Housing, excluding Nursing Care Homes and Bungalows, there is a firm conclusion that a fire alarm system 'operated as intended' directly relates to fewer fire related fatalities or casualties.

11.15.8 This preliminary finding may indicate qualifiers to the "Home Office"[91] conclusion that

> "*By combining IRS and English Housing Survey data, Home Office statisticians have calculated that you are around nine times more likely to die in a fire if you do not have a working smoke alarm in your home."*

11.15.9 This is a matter which would benefit from further investigation and discussion. The discussion should also determine with the benefit of more a larger data field whether these results are significantly relevant.

11.15.10 For Retirement Homes, Purpose Built Low Rise (1-3) Flat/Maisonette and Other Dwelling Types there was a higher percentage of fire related casualty or fatality in accidental fires in which the fire alarm did not perform as intended.

11.15.11 This would indicate that indicate that a working fire alarm system may have contributed to the reduction of accidental fires that result in a fire related fatality or casualty.

11.16 Investigation Area 4: Is there any statistical indication that older occupancy types in Relevant Dwelling Types and Relevant Property Types have attempted an evacuation which has resulted in having to be rescued by fire service personnel.

11.16.1 This review used the Key Influencers visual in Power BI. The Key Influencers visual is a Power Bi feature that helps identify the factors that have the most significant impact on a particular outcome. It uses machine learning algorithms to analyse the relationships between different variables and determine which factors have the most influence on a selected metric. This visual is particularly useful for exploring patterns, discovering insights, and understanding the factors that drive specific outcomes or metrics within a dataset.

11.16.2 This Area of Investigation could provide preliminary indication of performance that the following statements of intention form ADB.

- There are sufficient means for giving early warning of fire to people in the building.
- Where necessary, escape routes are sufficiently protected from the effects of fire and smoke
- There are appropriate provisions to limit the ingress of smoke to the escape routes, or to restrict the spread of fire and remove smoke.

11.16.3 Review used the Casualty in fires and fire-related fatalities dataset, to determine which factors affect the location of older victims and compare those factors to determine the relative importance of these factors.

11.16.4 This review will compare

- The location of the fire start,
- The location of the victim start,
- Location of victim found.

11.16.5 The main grouping of locations are

- In the room or compartment of fire origin and
- other room or compartment than the fire of origin.

11.16.6 The type of injury will also be used as a factor, those victims that are:

- Recorded as being overcome by gas, smoke or toxic fumes; asphyxiation or other breathing difficulties assumed occupants to have no direct contact (burning clothing or bed

91 *HM Government, Detailed analysis of fires attended by fire and rescue services, England, April 2021 to March 2022 (Home Office, 2022).*

sheets) with the fire, either as a contribution to an ignition event or as part of pre-movement activities, for example attempting to fight the fire; or

- Recorded as severe or slight burns and a combination of burns and being overcome by gas/smoke are assumed to have had direct contact with the fire either as a contribution to an ignition event or as part of pre-movement activities.

11.16.7 This review will be made without reference to Specialised housing Typologies due to the data anonymisation process of sensitive data previously discussed.

11.17 Investigation Area 4, Findings

The Review from Power Bi indicated that for older persons:

11.17.1 For a fire in a Dwelling when a casualty's starting location is the same compartment as the fire origin they were 6.5 times more likely to be found in the same location and suffering from breathing injuries (44% compared to the average distribution of 16.5% for non-older persons). This is the same for casualties suffering from burns but at a lower likelihood at 3.72 times at 46.3% when compared to the average of 30.2%, for non-older persons.

11.17.2 This may indicate that an older person was significantly less likely to be effective in being able to reach a place of relative safety than a person who was not considered an older person.

11.17.3 For a fire in a Dwelling when a casualty starting location was not the same compartment as the fire origin in a dwelling they are 1.63 times more likely to be found in a different location to the fire and suffering from burn injuries (82% from an average distribution of 64% for non-older persons). This is the same for casualties suffering from breathing but at a lower likelihood at 1.64 times at 89% when compared to the average of 78.3% for non-older persons).

11.17.4 This may indicate that when a fire started in another room an older person was slightly more likely to interact with the fire and sustained burns, but were able to leave the compartment with the fire.

11.17.5 For a fire in a Dwelling when a fire starts in a living room an older casualty was more likely to be found in the same compartment, i.e. they have not moved from the compartment. When those injures are breathing injuries, 1.8 times more likely to be an older person (43.5 % of casualties from an average distribution of 26.9% for non-older persons). When the recorded injury are burns the likelihood is reduced to 1.42 times at 58% of casualties (from an average distribution of 46.2% for non-older persons).

11.17.6 When the fire starts in a kitchen the older casualty is slightly more likely to be found in a different compartment. When those injures are breathing injuries older persons are 1.08 times more likely at 73.7 % of casualties (from an average distribution of 71.4% for non-older persons), this is the case for older casualties with burns but with a higher likelihood at 1.24 times at 57.8% of casualties (from an average distribution of 51.8% for non-older persons).

11.17.7 This indicates that when the fire was in the living room or kitchen, but the casualty was in another compartment, they were less likely to be able to leave their compartment. This may indicate that older persons were less likely to sense, and understand fire cues or participate in effective decision making or making proactive actions to move themselves to safety.

11.17.8 When an older fire fatality victim was in the same compartment at the fire when the fire started, they were 10.1 times at 78.4% more likely to be found in that same compartment when the cause of death was being overcome by smoke (from an average distribution of 44.1% for non-older persons).

11.17.9 This may indicate that older persons were less likely to sense, and understand early fire cues or participate in effective decision making or making proactive actions to move themselves to safety. It can also indicate a physically inability to be move effectively towards the exit of the compartment during a hazardous scenario.

11.17.10 When an older fire fatality victim was did not start in the same compartment as the fire, when the fire started, they were 2.87 times at 94.5% more likely to be found in a compartment that does not contain the fire when the cause of death was being overcome by smoke (from an average

distribution of 32.9% for non-older persons) and 4.73 times more likely at 84.62% when they succumb to burns (from an average distribution of 17.89% for non-older persons).

11.17.11 This illustrates a complex set of pre-movement activities, that could indicate an unsuccessful contact with the fire (indicated by the burns) and resulting unsuccessful evacuation.

11.18 Overall Conclusion

11.19 There were two Objective 2 tasks set out by,

- Further research specialised housing types, generating information on risk across building typologies.
- Review the effectiveness of different strategy options to address the established risks (see paragraph 11.1).

11.20 This subsequently resulted in the following Objectives.

1. To identify and evaluate the available evidence regarding the effectiveness of fire safety measures within specialised housing typologies designed in accordance with the requirements of the Building Regulations 2010 and current ADB (Approved Document B) guidance.
2. To compare and evaluate the available evidence on the effectiveness of ADB guidance specialised housing typologies in relation to the guidance given to residential non-specialised housing typologies.

3. If there is a difference in the measured effectiveness of ADB guidance:
   - Identify the potential cause for the difference
   - Discuss whether the differences between the typologies could still result in buildings that are compliant with the Building Regulations 2010
   - Identify design opportunities that could be considered which have the potential to minimise the difference

11.20.1 The research adopted the following two methodologies: Review of Quantified and Qualitative Research on Residential Fires and Older Persons, and Review of UK Fire Statistics

11.20.2 The Review of Quantified Research on Residential Fires and Older Persons involved the extension to the previous literature review to summarise further the existing knowledge on the statistics related to the fire risks for older persons. They also provided an additional overview to illustrate the broader research landscape and its potential contributions to future research advancement.

11.20.3 The Review of UK Fire Statistics had four Areas of Investigation:

- **Investigation Area 1:** Is there any statistical correlation that would indicate that fire spread is more extensive in Relevant Dwelling Types with one or more older occupants, then Relevant Property Types
- **Investigation Area 2:** Is there any statistical indication that older 'Household occupancy types' have been rescued more times when compared to younger occupancy types, in particular in relation to Relevant Dwelling Types and Relevant Property Types.
- **Investigation Area 3:** Is there any statistical indication that the presence of a working fire alarm system correlates to a decrease in the recorded number of fire-related casualties or fatalities in older occupancy age groups in Relevant Dwelling Types and Relevant Property Types.
- **Investigation Area 4:** Is there any statistical indication that older occupancy types in Relevant Dwelling Types and Relevant Property Types have attempted an evacuation which has resulted in having to be rescued by fire service personnel.

11.20.4 The Review of Quantified and Qualitative Research on Residential Fires and Older Persons concluded that there is no evidence was currently found directly regarding the effectiveness of fire safety measures in specialized housing typologies designed in accordance with the Building Regulations 2010 and current ADB guidance. The absence of evidence neither confirms nor disproves the effectiveness of fire safety measures in specialized housing typologies. It simply indicates a lack of available evidence at this time to support or favour one conclusion over

another. This absence emphasizes the importance of conducting further investigation or exploration to gather additional evidence before making a conclusive judgment.

11.20.5 A summary of our findings of the UK Fire Statistics four Areas of Investigation

11.20.6 Investigation Area 1: No evidence was found indicating an escalation in fire damage resulting from the prescribed building design guidance outlined in ADB. Therefore, it suggests that the current guidance does not appear to be significantly contributing to an increase in fire-related incidents.

11.20.7 Investigation Area 2: Within the described time periods, an observable rise in the proportion of rescues involving individuals aged over 80 and those between 65-79 years old was noted. Interestingly, the percentage difference between three-year periods for total accidental fires involving occupants over the pensionable age was smaller compared to the percentage difference for rescued victims within the same age groups. This implies that while there may be an increase in the number of rescues, the overall incidents of fires involving older individuals remains relatively stable.

11.20.8 Investigation Area 3: Analysis of Sheltered Housing, Nursing Care Homes, and Bungalows identified a counterintuitive pattern. Incidents where occupants were first alerted by the building's fire alarm showed a higher proportion of fire-related casualties or fatalities than those where occupants were alerted by other means, such as smoke, flames, neighbours, or staff intervention. This finding does not imply that alarms are ineffective; rather, it highlights that casualty outcomes in these settings are strongly influenced by other factors, including the vulnerability of occupants, staffing levels, and evacuation procedures. It underlines the complexity of fire incident dynamics in older occupancy groups, where multiple interacting factors beyond alarm operation can shape outcomes.

11.20.9 Investigation Area 4: In the context of fire incidents involving older individuals, distinct challenges were observed. The review indicated that an older person was significantly less likely to be effective in being able to reach a place of relative safety, than a person who was not considered an older person. This may indicate that older individuals may face difficulties in perceiving early fire cues, making effective decisions, and taking proactive actions for self-evacuation. Physical limitations may also contribute to a diminished ability to swiftly navigate towards an exit. These findings highlight the complexity of pre-movement activities supporting the conclusion that reducing exposure to fire hazards for older persons is a profoundly complex issue intrinsically linked to the individual's risk factors and unmeasured contribution from pre-fire events and interventions.

11.20.10 There was no evidence that would lead to the conclusion that there is difference between the intention or guidance between specialised housing typologies and other buildings that would indicate a measure of effectiveness of ADB guidance.

11.20.11 The following areas of further research have been identified:

- Investigation of protective action decision–making process undertaken by older persons and the influence of other persons in that process.
- Review of the effectiveness of automatic fire alarm and warning systems and other warning systems in the decision-making process in older persons in relation to Specialist Housing fire scenarios.
- Investigation of whether the characteristics of the internal layout of dwellings could increase the probability that an older person would be able to move into an area of relative safety.

12 Objective 2: Instruction 2

12.1. Instruction 2

Under Objective 2 of the research DLUHC directed the following further research to be considered:

Research the benefit of protected storage for mobility scooters.

12.2. Methodology

12.2.1. From the Objective 1 research (Figure 37) it was seen that typologies 1 and 2 were more likely to have mobility scooter storage provided compared to other typologies and the majority of these have been built since 2010 (Figure 38). As such typologies 1 and 2 were targeted for this instruction.

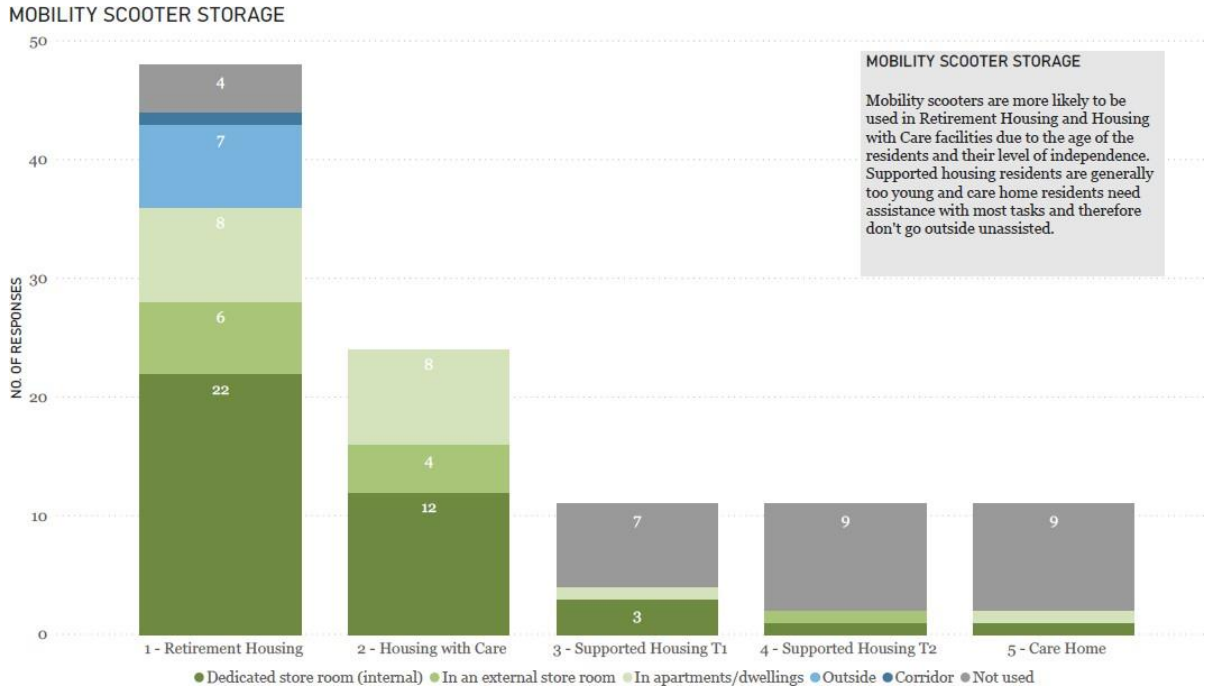


Figure 37 Mobility Scooter Storage, Appendix 1 Quantitative Analysis, Page 125

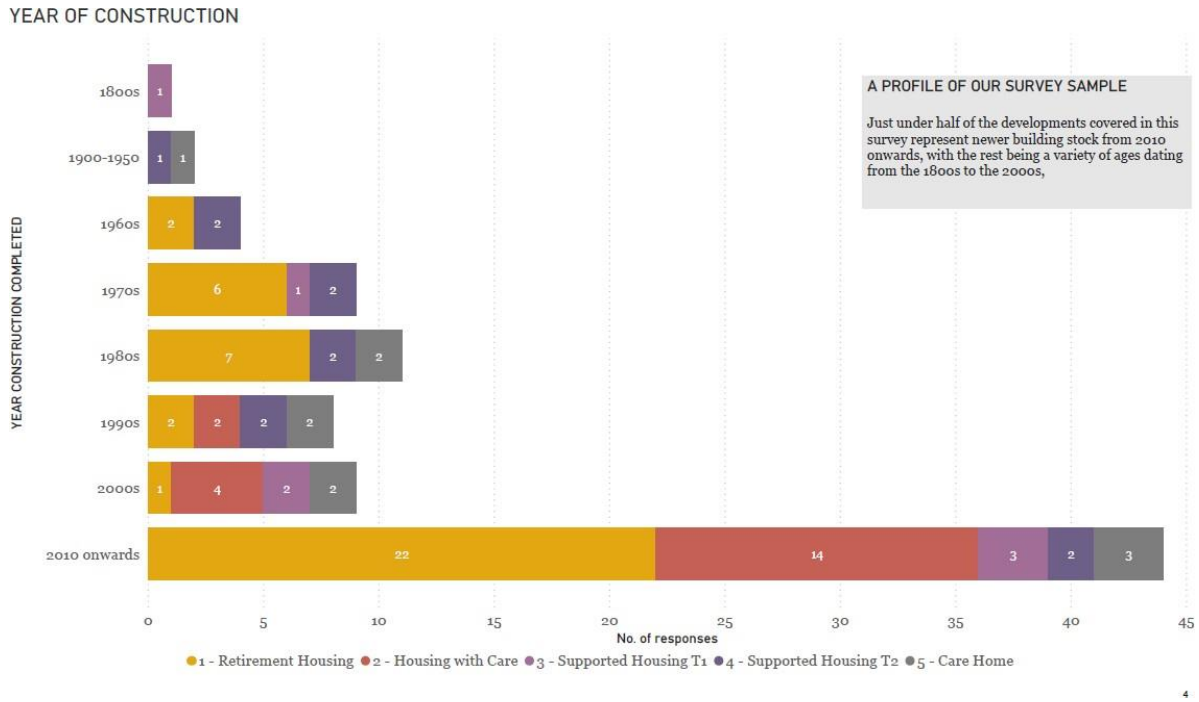


Figure 38 Year of construction, Appendix 1 Quantitative Analysis, Page 111

12.2.2. From the case study evidence already gathered in Objective 1, the following attributes were used to inform instruction 2 of the Objective 2 portion of the research:

- Relevant typologies which have mobility scooters (i.e. typologies 1 & 2).
- Location of the developments, including distances from local amenities.
- Building arrangements e.g. multiple buildings versus single building.
- Design differentiators such as atrium or vertical core circulation.
- Position of mobility scooter store.
- Building age.

12.2.3. Using these attributes, 5 buildings were selected. Each varied in terms of building design and approach to the storage of mobility scooters. In general, they were considered to embody good practice in order to provide a suitable research sample.

Building 4 was the only exception to this and was chosen as an example of external storage for mobility scooters. It transpired, on visiting the building, that the store was actually a later extension to a 1980's building which enclosed the escape staircase, rather than being a standalone external store. An example of a standalone external store was therefore not explored, as no examples were found through either the Objective 1 research or from discussions with the Technical Steering Group.

12.2.4. A proforma for building visits was compiled which comprehensively covered the following issues: -

- What is the location, form, size and construction of the storage?
- What are the access arrangements into the store and how do these operate in the event of a fire alarm activation?
- Consider physical aspects of the storage such as the security, lighting, finishes, charging points, wall protection.
- How many scooters can be stored and charged at any one time?
- What is the fire performance of the enclosure including access door?
- Are residents using the storage, and if so, is it being used in the manner it is intended?
- What is the resident's opinion of the storage?
- What is the building manager's view on the storage and its use?

12.2.5. Building visits were then arranged to observe the storage in operation. Interviews with the building manager and a resident user were carried out using the proforma to systematically gather data for analysis.

12.2.6. The data collated from the building visits and review findings were analysed against that collected during Objective 1 of the research to ascertain whether sufficiently robust quantitative data have been compiled to support the findings.

12.2.7. The data from building visits was then analysed to establish the benefits dedicated storage provides in terms of the following:

- Economic benefits
- Social benefits
- Operational benefits
- Health & Safety
- Environmental benefits

12.2.8. At the time of agreeing the methodology for the research for instruction 2, it was accepted that there would be potential limitations to the data being collected which would need to be further considered before drawing definitive conclusions. These limitations include:

- Limited number of visits.
- Buildings selected are not representative of the full spectrum of designs in UK building stock.
- Possible over emphasis on a particular viewpoint, such as from a resident or building manager.
- Limited number of resident responses.

12.3. The Growing Use of Mobility Scooters

12.3.1. An analysis of the impact of Mobility Scooters on their users[92] in the UK showed that scooter use is more common in people over 65 and it is estimated by ONS (2019) that from mid-2018 to 2043 the number of people aged 65 years and over will increase by 3.6 million which is a rise of 30%[93] concluded that sales in the UK at least were increasing 5 – 10% a year.

12.3.2. Barton also concluded that 54% of those who owned a mobility scooter also owned a wheelchair and 27% owned more than one type of mobility scooter. An Australian study showed that visiting shops was the most common use and that they were used 3 to 5 times a week.

12.3.3. The growing benefit/demand for scooter stores has been reflected in specialised housing design guidance, evolving over many years including, but not exclusively:

- The Guide to Abbeyfield Extra Care 1989[94] refers to 'wheelchair stores'.

- The Abbeyfield Design Guide for remodelling and refurbishment 1999[95] described Wheelchair storage including electric mobility buggies and scooters. It recommended:

  'a locked and ventilated store where these buggies can be recharged is essential. At least four double sockets located at 1000mm above finished floor level should be provided. Such a store should ideally be accessible from both inside and outside the building. Allow a space 1200 x 800mm for each scooter.'

94

92 *Thoreau, The Impact of Mobility Scooters on their Users. Does their Usage Help or Hinder? A State of the Art Review. Journal of Transport and Health (University College London, 2015).*

93 *Barton, et al., Mobility Scooters: A Market Study. (Research Institute for Consumer Affairs, 2014)*

94 *The Guide to Abbeyfield Extra Care, The Philosophy of Designing and Caring for the Frail Elderly (The Abbeyfield Society & Salmon Speed Architects, 1989)*

95 *PRP Architects, Design Guide for the Remodelling and Refurbishment of Abbeyfield Houses (Housing LIN, 1999)*

- The Abbeyfield Design guide for the development of new build accommodation for older people 2001[96]described a *'dedicated store which should include charging facilities*.'

- Housing LIN Factsheet no 6, published in 2008[97] recommended a *'large re-charging store for electric buggies and scooters 25-30m²*.

- The later LIN Fact sheet no 6, Design Principles for Extra Care, published 2020, recommends '1 mobility scooter per 5 dwellings'.

- The 2022 version of the Metric Handbook 7th Edition[98] in chapter 23 Housing for older people, under communal facilities calls up a 'Mobility scooter store' recommending 1 scooter space per 5 dwellings.

Beyond such broader design guidance, more specific fire measures are recommended in the following guides:

- In 2017 NFCC published Fire Safety in Specialised Housing which outlined the issues around storage of mobility scooters, highlighting that storage within common escape routes creates:

  'potential that escape routes will become impassable and residents could be placed at significant risk in the event of a fire. Therefore, appropriate measures must be considered within the fire risk assessment to address the risks posed by the storage and charging of mobility scooters.'[99]

  In addition to the NFCC guide, appendix 5 within this document provides further specific guidance on different types of storage of mobility scooters and fire safety measures which should be considered for their safe storage.

- In NFCC's 2018 Mobility Scooter Guidance for Residential Buildings document[100], detailed advice is provided which is aimed specifically at those who manage, advice or enforce standards in residential buildings as well as those who undertake fire risk assessments. This document reinforces the importance of appropriate management regimes within buildings where mobility scooters are used. It is the widest ranging of all documents where specific measures are recommended, which can clearly be seen from Table 8 below.

12.3.4. Table 8 draws together the specific fire recommendations from these and other documents such as BS9991[101], and Home Office guidance 'Fire safety in purpose-built blocks of flats[102] . As noted from Objective 1, these documents refer to detailed fire measures pertaining to scooter storage:

[96] PRP Architects, Design Guidance, for the development of new build accommodation for older people (Abbeyfield Society, 2001).
[97] PRP Architects, Factsheet 6: Design Principles for Extra Care Housing (Housing LIN, 2008).
[98] Buxton (Editor), Metric Handbook Planning and Design Data, seventh edition (Routledge, 2022).
[99] National Fire Chiefs Council, Fire Safety in Specialised Housing, Page 129 (NFFC, 2017).
[100] National Fire Chiefs Council, Mobility Scooter Guidance for Residential Buildings (NFFC, 2018).
[101] BSI, 9991:2015 Fire safety in the design, management and use of residential buildings – code of practice (incorporating corrigendum No.1) (BSI, 2015).
[102] HM Government, Fire safety in purpose-built blocks of flats (under review by Home Office) (Home Office, 2011).

Table 7: Design recommendation for mobility scooters

Scooter storage	Aspects described						
Document	**Features**	**Internal enclosed**	**Fire rating**	**Door**	**AFD**	**Management**	**External location**
BS9991	chargers	*yes*	30 minutes minimum	/	/	/	/
Mobility Scooter Guidance for Residential Buildings NFCC	chargers	*yes*	60 minutes	Fire door with SC	*yes*	No charging at night. Scooter Insurance and Maintenance regime.	Must be min 6m away from building. Fire resisting and secure enclosure to avoid arson.
Housing LIN Technical brief no 5 Fire Safety in Extra Care Housing	chargers	*yes*	/	/	'local application misting to buggy charge'	/	/
Housing LIN factsheet no 6 Design Principles in Extra Care	/	*yes*	/	/		/	/
Fire Safety in Block of Flats, LGA	chargers	*yes*	'fire separation'	/	/	/	/
ADB Vol 1: Dwellings	/	/	/	/	/	/	/

12.3.5. The variation in scope and detail within the recommendations across these documents is notable with the NFCC guide being the standout, covering all aspects whilst ADB vol 1 dwellings covers none.

12.3.6. ADB vol 1 does not refer to scooter storage but it does describe a 'place of special fire hazard' as including storage space for fuel or other highly flammable substances and that such spaces should be enclosed in 30minute fire rated REI minimum.

12.3.7. ADB vol 2 similarly categorizes stores as ancillary rooms requiring enclosure of 30-minute fire rated REI minimum.

12.3.8. These aspects then informed the content of the proforma questionnaire produced for the building visits and recorded in the associated Table 10: Visit Results, to determine to what extent these different recommendations have been implemented and their effectiveness in practice.

12.3.9. ADM was reviewed and it sets out no requirements for scooter storage.

12.4. Building Visits

12.4.1. With assistance from the Technical Steering Group, a total of 5 buildings were chosen to cover variation in the design approach to the developments and the types of storage provided within them.

12.4.2. Table 9 below, summarises the different aspects which were used for selecting buildings for the visits, for example building age and distance from local amenities.

Table 8: Building selected for mobility scooter storage survey

Building No.	Location	Typology	No. of storeys	No. of flats	Building arrangements/ design differentiators	Position/ disposition of scooter store(s)	Approx. building age	Distance from local amenities
1	London Borough of Greenwich	1	7 & part 8	170	Five separate cores joined at ground floor with carpark below podium below garden. Includes 'Village Hall for much wider village masterplan.	3 no separate scooter stores all accessed externally from below podium in the car park, and accessed internally via residential cores.	2015	1/4 mile to village local centre and train station.
2	Hampshire	2	3	75	Single building Internal atrium	Internal access only. Individual multiple stores on each level of building, next to lift core.	2010	1/4 mile fleet Rd main shopping street
3	London Borough of Barnet	2	3 & part 4	53	Single building Internal atrium	Main central scooter store at ground floor, external entrance and internal into building atrium.	2019	1 mile to single supermarket, 100 yards from limited local parade of shops
4	London Borough of Wandsworth	1	3	58	Single building standard, double-banked corridor access	External scooter store added by converting existing building 'porch' at base of emergency staircase.	1980's	1/2 mile to main shopping area, 400 yards to local shops
5	Yorkshire	1,2 & 5	3	140 (95 flats 45 care beds)	Separate village blocks with single cores (4 no). 45 care beds plus flats in largest block (no 1) with standard corridor access.	Store at ground floor with external entrance and internal access across village.	2022 (phased)	1/4 mile to small parade of shops. Over 1 m to main shopping centre.

12.4.3. Contact was made with the building management and dates were agreed for visits. All building visits were led by PRP. For buildings 1, 3 & 4 a representative from the National Fire Chiefs Council also attended. The manager provided a tour of the communal parts of the building and then approached the scooter store to demonstrate the way a resident/fire brigade would access the store. PRP then inspected the scooter store and completed the proforma, taking photographic evidence. The manager was then asked questions prompted by the proforma as well as providing further commentary from their own perspective.

12.4.4. Similarly, a resident was interviewed, prompted by the proforma questionnaire. In some instances, a resident had previously been interviewed by the manager beforehand and their feedback was given by the manager instead.

12.4.5. The proformas were filled out to record the information and feedback received from each visit in detail. The high-level results were then pulled together in 10: Visit Results, see below, to allow a broad comparison of the results across the buildings.

12.5. Visit Results

Table 9: Visit Results

Building No.	Location	Size of storage m2	scooter capacity	Scooter capacity as percentage of flats	Approx use	Parking in flats	Fire brigade access	Construction	Features/charging	Internal enclosed	Fire rated enclosure	Internal fire door	AFD/suppression	Management commentary	Resident commentary	Fully external location	Observations
1	London Borough of Greenwich	Store 1 - 3 x 5m. Store 2 - 4 x 7.5m. Store 3 - 3 x 5m.	Store 1 - 5no. Store 2 - 10no. Store 3 - 5no. 20 in Total	12%	20 regular uses. Capacity under presure. More would use if space permitted.	Approx 10 residents. 6% of flats.	via redidential cores and via carpark below podium	Blockwork, cementious faced insulation board	standard sockets, CCTV	yes	yes block work assumed 60 mins	yes solid FD30 opening direct to carpark no glazing, double . Self closing.	Heat detection only. No sounders.	Only scooters. No other aids including wheelchairs are permitted. Large scooters banned from reception and lounge etc due to collision damage.	Doors are not auto open, so residents have to open and close them which means getting on and off scooters which is difficult. No vision panels makes even harder. Transferring from flat to store is not possible for those who can't walk as parking a wheelchair is not permitted in the scooter stores. This means those people are forced to park their scooter in their flat. The stores are always full and more are needed. Lots of bad parking blocks access and transfer. Bump at door threshold.	Partly as off naturally vented covered carpark	
2	Hampshire	2 stores per floor 6 no stores in total. Primary store (4.8 x 2.4m). Secondary store (3.4 x 4m).	Secondary 4 no. Primary 6 no. 30 in total.	40%	25 - 30 regular users. Of these 10 transfer using wheelchairs/walking aids which they then leave in the store until return.	4 residents. 5%	via main entrance and internal atrium circulation space	Plastered blockwork, plastered ceiling	standard sockets. Warden call emergy pullcord. Mechanical vent extract.	yes	yes block work assumed 60 mins	yes FD30s glazed auto open. Self closing.	yes aquamist fire suppression and detection. No sounders.	Mangagers considering scooter registration scheme and numbering due to visitor scooters putting pressure on resident capacity. Large scooters banned from dining room due to collision damage.	4 other residents park in their flats because transfer distance is too long/stores too full. The small store is harder to turn into from the corridor. Not enough space in lounge/dining for scooters when an event is on.	no	
3	London Borough of Barnet	Main store (7.8 x 3.7m). Future stores 2 no 4.8 x 2.4m)	Main store 8 but 6 if cycle racks fitted. Future stores 2 no, capacity 4 no each so a further 8 possible giving 16 no.	15% as current main store. 30% if all future storage capacity used.	Only 2 - 3 regular users. Local shops adjacent to building.	2-3 residents. 5%	direct from outside and adjacent to the main entrance	Blockwork, plaster ceiling	standard sockets. Wall buffer rails, CCTV . Mechanical vent extract.	yes	yes block work assumed 60 mins	yes FD60s glazed auto open. Self closing.	yes sprinklers, detection and breakglass. No sounders.	Not heavily used for scooter parking.	2 - 3 other residents park scooters in their flats because transfer distance is too long.	no	
4	London Borough of Wandsworth	Store 1.5 x 2.5m	1 no	1.70%	Only 2 regular users	1 resident. 1.7%	via main entrance and internal circulation corridors. Very hidden away	Part external brickwork part timber infill and timber ceiling.	single standard socket	yes	no	no	none	Too small to use plus door is almost in accessible with a step at the threshold and not wide enough etc. To stop parking/charging in the escape stair the cleaners socket has been removed in the stair. Store should be located at front of building near main entrance as it can only be accessed internally due to garden steps.	2 residents use scooters and can't fit both in the store. Door wedged open to facilitate access as the maglock wont open unless alarm activates. Therefore one parks in the escape stair. They have been complaining to the building manaement that the store is not good enough. One other resident parks her scooter in her flat as transfer is too far.	no	The scooter store blocks escape from the stair to its final exit as the store has been created by enclosing a porch outside the original final exit. Wedging open this door which has also become the store door means the scooter store is open to the escape stair compromising it, although as the door is not a fire door the stair is compromised even when shut. In addition the external door has a key lock which is not in accordance with ADB for escape.
5	Yorkshire	3 no stores. Building 1 store 3.7 x 6.4m. Building 2 no store. Building 3 2.8 x 6.5m. Building 4 2.8 x 6.5m.	7 no in building 1. 5no in building 3 and 5no in building 4 giving a total of 17 no	18% based on flats only (assume no care home use).	The blocks which are full are using stores to capacity.	None	direct from outside and adjacent to the block main entrances	Plastered blockwork, plaster ceiling	standard sockets	yes	yes block work assumed 60 mins	yes FD60s glazed but not auto open. Self closing.	Detectors, no sounders. Breakglass	No scooters within the building beyond the scooter store, only powered wheelchairs permitted. Internal door should be auto. Lines marking parking bays would be good.	Some residents transfer using wheelchair. Timer on external door needs adjusting to give enough time to exit. Store often too full so that you cant reach the socket for charging. Internal door should be auto opening, radio controlled fob for inner and outer door suggested.	no	

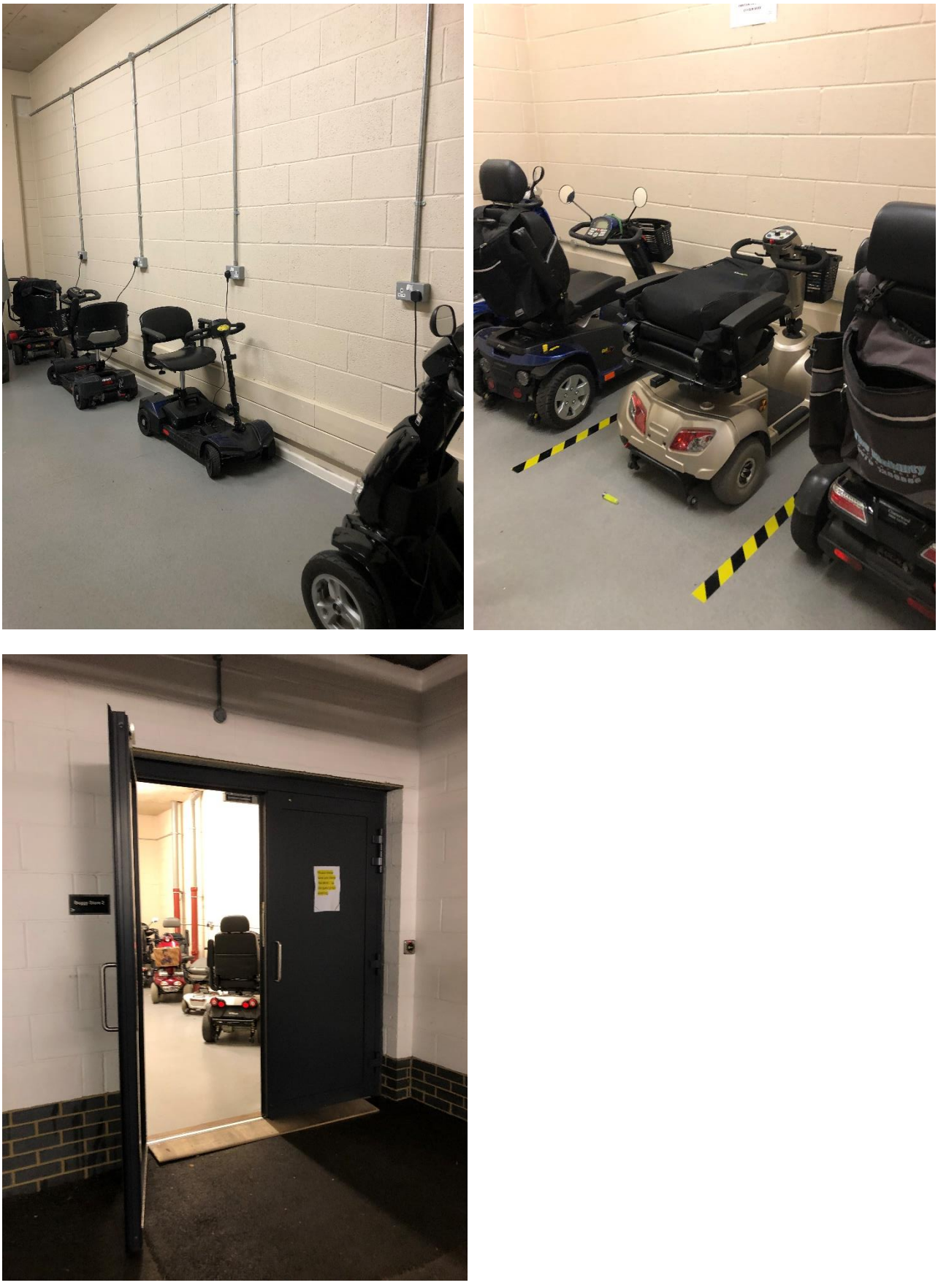


Figure 39 Building 1 images showing charging sockets, low level buffer rail, taped out bays to prevent bad parking & double access doors

Figure 40 Building 2 images showing painted plastered walls, slip resistant vinyl floor, warden call alarm pull, internal access door powered action with fob operation and bike being stored

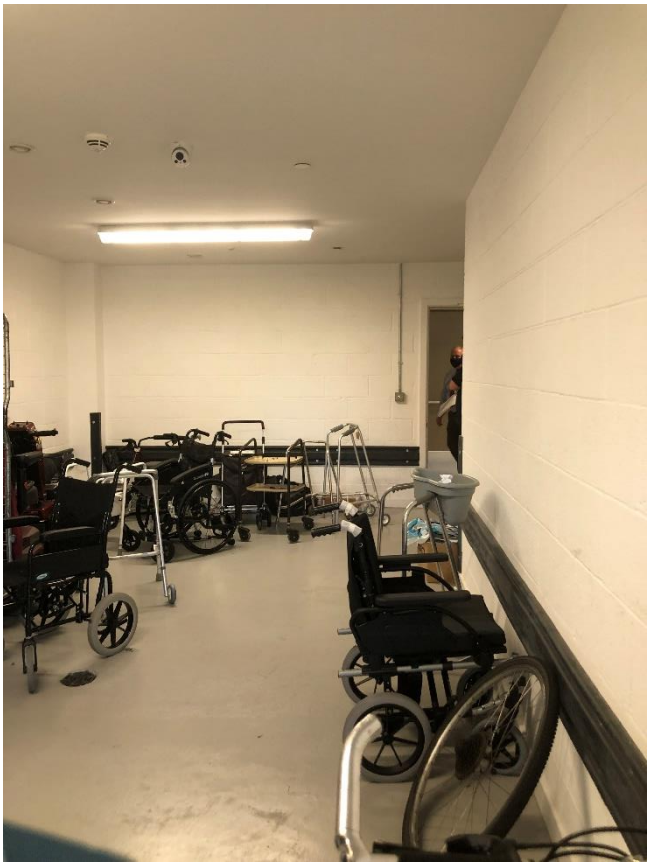
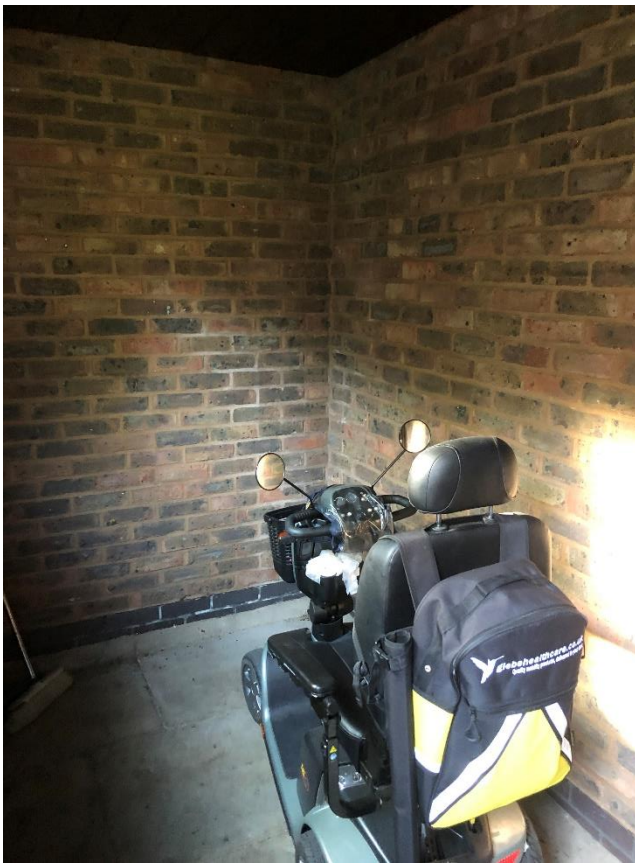


Figure 41 Building 3 images showing powered external door, wall protection buffer rails, internal door with fob operation, painted concrete walls and floors



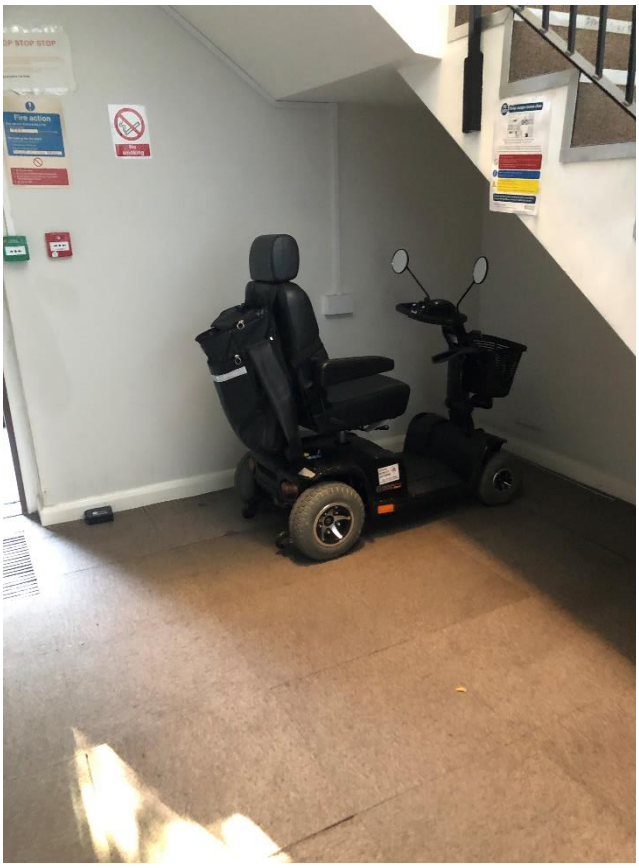


Figure 42 Building 4 images showing under sized store, overspill parking in the escape stair, external door with inappropriate ironmongery

Figure 43 Building 5 images showing a wide variety of scooters and wheelchairs parked, powered fob operated external access but with manual operation internal access door

12.6. Fire Aspects

12.6.1. Summarised below for all five buildings, are the percentage of buildings where certain features were present:

- Charging facilities 100%
- Enclosed 100%
- 60-minute fire rating 80%
- Fire door with self-closer 80%
- Automatic fire detection 80%
- Fire suppression 40%
- No charging permitted at night 0%
- External location 40% (Bldg. 1-part basement and bldg. 4-part lean to)

12.6.2. Building 4 was (as previously noted) significantly older than the others visited and was expected to demonstrate a retrofit example of a scooter store. However, on visiting it was not considered to represent good practice on a broad range of issues. Specifically, the impact of the scooter store on evacuation from the fire escape stair, was contrary to the Building Regulations and the Regulatory Reform Order, creating a dangerous route from the stair through a store and encouraging scooter parking in the escape stair itself.

Given that it was effectively not a satisfactory arrangement for a designated scooter store, or in any way representative of good practice, this building is not included in the calculations. The percentages for remaining buildings 1, 2, 3 & 5 are then as below, increasing the overall percentages achieved accordingly:

- Charging facilities 100%
- Internal enclosed 100%
- 60-minute fire rating 100%
- Fire door with self-closer 100%
- Automatic fire detection 100%
- Fire suppression 50%
- No charging permitted at night 0%
- External location 25% (Bldg. 1-part basement car park)

12.7. Capacity and Usage

12.7.1. Included within the results table are the capacity and usage, taken from the management and resident responses, again excluding building 4 as it is an outlier as previously explained with space for only one scooter and the location of the store was not considered to represent good practice.

- Scooter storage capacity to flats varied between 12% and 40%, with an average across the visited buildings of 21.25%. This equates to an average of 1 scooter space per 5 flats. This is in line with guidance in the LIN factsheet no 6[103] and the Metric Handbook 2022[104] both of which state the same.

- Based on interviews with the building managers, flats where mobility scooters are parked inside the dwelling are at around 5%. This equates to an average of 1 scooter per 20 flats. Some managers reported that the scooters were more often parked in bedrooms than any other space in the flat. Parking in flats could be an issue in a scooter fire particularly if in the bedroom while the resident is asleep or in the hallway which provides escape to the flat front door.

103 *Housing LIN, Design Principles for Extra Care Housing (3rd Edition), Factsheet no 6. (Housing LIN, 2020)*

104 *Buxton, P, (ed.), Metric Handbook, Planning and Design Data, Seventh Edition (Routledge, 2022)*

- Buildings where the residents and management report heavy use and lack of scooter store capacity are 75%, suggesting that the capacity seen could be increased to suit demand. This included building 2 which at 40% scooter provision still reported pressure on capacity.

12.8. Comparison with Objective 1 Data

12.8.1. Objective 1 survey data relating to mobility scooters questions for typologies 1 and 2 only, has been extracted and further analysed. The relevant questions from the Objective 1 survey were;

Q14 'How many residents use mobility scooters/buggies?'

Q22.2 'Number of apartments?'

Q30 'Where are mobility scooters/buggies stored? Tick all which apply

Q30.1 in an external store room?

Q30.2 in a dedicated store room within the building?

Q30.3 In apartments?

12.8.2. Q14 asks how many residents use scooters rather than how many parking spaces are actually present so it is not possible to directly compare this to the capacities from the building visits. However, across all 66 schemes;

on average there was found to be 0.115 scooter users per flat

12.8.3. Again, this is lower than in the buildings visited in Objective 2. This is understandable given the age of many of the buildings surveyed in Objective 1 and the low percentage of schemes with a dedicated store of any kind which would be expected to limit scooter use.

12.8.4. For a fairer comparison with the buildings visited in Objective 2, taking only the 37 schemes from the Objective 1 survey those reporting a dedicated store (internal and external), on average there was found to be 0.162 scooter users per flat.

12.8.5. As expected this is higher, and indicates that the presence of a dedicated scooter store encourages more scooter use.

12.8.6. For Q30 from the survey answers, the percentages of schemes which allow storage of mobility scooters (not actual capacity) are;

Q30.1 External store room	4.5%
Q30.2 Dedicated store within building	51%
Q30.3 In apartments	9%

12.8.7. Out of 66 buildings surveyed in Objective 1, only 3 of the schemes had two forms of storage present in the same scheme. All three had a dedicated store within the building and parking in flats was also present. They were all typology 2 schemes. This suggests an issue with the internal dedicated store such as a lack of capacity or excessive transfer distance.

12.8.8. Of the buildings visited in Objective 2, which have scooter stores, 75% also reported parking in flats. It is therefore probable that scooter parking in flats in the Objective 1 surveyed schemes is significantly more prevalent than the 3 reported schemes from the survey would suggest. Perhaps this is simply because management, who completed the survey questionnaire in Objective 1 are unaware of the practice.

12.9. Objective 2 Findings

12.9.1. General

From the evidence collated within objective 1 of this report the main fire risks associated with mobility scooters include the following;-

- Mobility scooters have an increased risk of catching fire when charging
- Mobility scooters have high intensity fires due to the lithium batteries
- Mobility scooters where parked in escape routes hinder evacuation
- Mobility scooters increase fire load if parked in corridors

12.9.2. Residents

The feedback from residents is mainly related to pressure on capacity and the need for more scooter storage space. This suggests the average capacity of 21% seen in the visits is not sufficient and there would be benefit in increasing it. Even at 40% building 2 residents and staff reported pressure. Where capacity was an issue, residents reported parking in flats instead.

Increased scooter storage could facilitate scooter use and associated accessibility for residents with attendant social and economic benefits to the wider community.

12.9.3. Location and resident use

Where local shopping facilities were good, such as buildings 1 & 2 residents and staff reported that mobility scooters were popular. In building 2 scooter stores were seen as a benefit to prospective residents on first viewing the building. For more residents to be able to utilise shops and facilities is clearly of social benefit to the residents. The bricks and mortar shopping experience have a social function of more importance for the residents than the average person. Where such facilities and shops were less accessible, such as in building 3, usage of the store was lowest.

12.9.4. Internal resident transfer

Another main issue reported was transfer using wheelchairs and other walking aids within the building from the resident's flat to the mobility scooter store. Longer distances in general to transfer deterred store use and was reported by residents. In addition, restrictive management regimes due to capacity issues preventing transfer are described in the management section below. Both these issues led to some residents parking mobility scooters in their flats instead of within the dedicated store.

Building 2 had a long-extended plan which it overcomes by having two internal stores on each floor and by the introduction of very generous atrium circulation, which aids scooter manoeuvrability. No transfer issues were raised in building 2 regarding the lift use required for scooters to reach upper floor stores which may be as a result of the oversized lifts.

In building 1 the store locations in the below podium car park resulted in extended transfer to and from the various building lift cores, from where external entry up to the flats is achieved. Residents reported that this discouraged use although each store was fully used at the time of the visit. scooters were discouraged taken to individual apartments by the management, however one resident did do this when no space in the store was available. Larger stores closer to the cores, would have significantly reduced transfer distances and improve capacity.

Internal routes are more difficult for residents to negotiate in scooters and risk internal building damage, personal injury to building users due to collisions, blocking of escape routes and potential ignition and fuel source. The provision of dedicated stores allows management better control to stop residents parking in their flats.

12.9.5. Store with external door (Fire Brigade access)

The NFCC member of the site visiting team noted that the Brigade will typically arrive at the main entrance of a building to access the fire alarm panel and building plans. Therefore, buildings with an external scooter store door, which is clearly visible from the main entrance door, will be obvious for the brigade to find. Such a location will enable them to quickly assess

the situation, should a scooter be on fire, particularly if the door is glazed as well. They would then be able to gain direct access to the scooter store fire and attack it without trailing hoses through the circulation spaces of the building with associated fire doors being held open. The external door also provides for smoke venting.

12.9.6. Store with external door (resident access)
An external scooter store door providing access to the store located adjacent to the main entrance is of benefit to the residents as well. The main external access path can be used and the scooter can be parked immediately on entry to the building, allowing transfer onward by means of wheelchair or walking aids which are more appropriate to internal use. On entering the building from the internal scooter store door, the resident would find themselves in the main reception/entrance area.

12.9.7. Store with no external door (Fire Brigade access)
This feature was seen in building 2, which had three floors and two stores per floor giving a total of 6 individual stores. All are far from the main entrance and spread across all three floors, meaning it takes time to find and reach them. In the event of a fire in a store, direct access from the outside would be beneficial for firefighting operations. Where there is no direct access from the outside, the F&RS may need to make their way through the corridors and atrium circulation space, trailing hoses through the building with associated fire doors on the route being wedged open. In building 1 the stores are located in the car park below the garden and are not visible on arrival and are deep within the plan. Where completely internal such as in building 2 there is no provision for natural smoke venting of the store to the outside.

12.9.8. Store with no external access door (resident access)
On entry to the building residents need to make their way through the corridors and atrium circulation space including navigating lifts. Such internal routes are difficult for residents to negotiate in scooters and risk internal building damage due to collision/scrapes. Dirt will also be brought in and spread around the building from the scooter wheels. Such stores within the building however do reduce transfer distances for residents.

12.9.9. Fire resistance of enclosure
These were typically concrete blockwork and so would provide a significant and robust level of protection to adjacent circulation spaces, which are typically protected escape routes for other parts of the building and so must not be compromised. Fire doors provided good levels of protection from the corridors, although the level of fire performance of the doors seen across the buildings somewhat varied, suggesting a lack of consistency.

12.9.10. Fire precautions such as sprinklers, mechanical ventilation, alarm coverage etc
These were seen to be the most varied aspect with the least consistency in provision, be it detectors, fire suppression, sounders, manual call points etc. A consistent robust approach would be beneficial. Detection and manual call points were typically provided. However, sounders were generally not provided and only building no. 2 & 3 had fire suppression/sprinklers in the mobility scooter stores and throughout the building. None had any ventilation related to fire within the mobility scooter stores, Although there was some mechanical extract and some louvred doors to building 1, where the mobility scooter stores opened off the car park.

12.9.11. Door functions fire and accessibility
Powered opening of doors to enter and exit mobility scooter stores are seen as best practice to facilitate ease of use by residents avoiding the need to physically disembark the mobility scooter to open the door. The inclusion of these was not always consistent across the stores visited which was raised by residents. Where they were not provided wedging open of doors was more likely with associated fire safety issues as seen at building 1 and 4. Glazed vision panels were generally seen and help greatly with accessibility. Only building 1 had solid doors, i.e. with no vision panels. Solving such visual accessibility measures by providing visibility panels to the doors could also improve functionality and reduce damage to the building fabric.

12.9.12. Parking bay sizes, marking out and manoeuvrability

Poor parking of mobility scooters by occupants, as seen at building 1, could be improved by the introduction of white lines. This would also facilitate safe transfer space and safe charging/cable management for occupants, avoiding trailing cable hazards. Suggestions to mark out these clearly were made by residents and management alike and it is clear that this would aid safer charging and transfer on and off scooters reducing the risk of trips, falls etc.

12.9.13. Charging and safety precautions

Charging was generally by means of 13Amp 230V 3 pin sockets. No measures either through management or automation were observed in any scheme visited to limit charging time, such as at night to reduce risk of fire to those asleep. Such measures are proposed by NFCC in their scooter guide. The guide does not provide evidence for the efficacy of such charging limitation, although it would seem to be logical if for example charging did not occur at night time when residents are asleep.

However, preventing charging overnight would seem to go against the practicalities of when people would be expected to want to charge their scooter. It would be inconvenient for many residents to only be permitted to charge in the day time for obvious reasons. The payment of charging was generally included in service charges and no metering of use was seen. Time limits and metering would encourage self-restriction of charging and reduction in fire risk. Neither of these were seen on the visits which aligns with what is generally seen.

12.9.14. Materials and finishes fire and aesthetics

Generally, economical, well-lit and simple robust decoration with white paint finish to fair faced block walls or drylined walls was common across the schemes and referred to by residents as positive. A variety of wall protection measures were seen including at low level and high level.

Given scooter design is varied the efficiency of protection and location would benefit from further consideration, although the low-level protection appeared to be best suited for the typical scooter design.

Doors into the stores were most prone to frame damage. Wider doors would reduce the collisions which cause this, as well as facilitate accessibility. Given the importance of the fire performance of these doors any measures which reduce damage and compromising of their performance would seem prudent.

Floor finishes varied from painted concrete to heavy duty slip resistant vinyl. Generally given the hard treatment these rooms will receive; the most robust finishes would seem the most appropriate.

12.9.15. Services

The use of CCTV and mechanical ventilation was sporadic across schemes. CCTV in particular could encourage use by creating an added feeling of security.

12.10. Management Considerations

12.10.1. Primarily the issues raised were around pressure on capacity and controlling the use of the stores. In building 1 the stores are so popular that the management have banned storage of any other aids such as wheelchairs and walking frames etc. in the scooter stores. The consequence of this, however, is that those who are unable to walk unaided from their flat are effectively unable to use the scooter stores. Therefore, they have effectively been forced to park in their own flats by the management regime.

12.10.2. It would seem that scooters are sometimes used internally for direct access from outside to the flat without any transfer via a store, particularly where a single scooter is owned. Use of scooters in communal areas was reported as causing damage to buildings and furniture leading to restrictions on the use of scooters (typically the larger types) in areas such as lounges and dining areas. Given some residents prefer to visit these communal facilities on a scooter due to the distance from their flat, this limits those residents' ability to use these facilities.

12.10.3. The potential for additional local internal stores to allow such residents to continue accessing these key areas would seem to be beneficial, such as are seen in building 2. Where parking in flats is common damage to flat front doors was seen as in building 2, where generous parking in the halls of the flats is provided.

12.10.4. Safe scooter maintenance regimes and testing were not mandated by the management teams visited although some do require insurance such as in building 1 for damage to the building fabric, which has been a particular problem in that building.

12.10.5. Issues of visitors parking scooters in the circulation areas, blocking escape routes in significant numbers has been reported in building 2. For management this is an issue as it is often difficult to determine who they belong to, limiting their ability to keep the escape routes clear. In response to this the management were considering a scooter registration scheme with numbered markings on the scooters. Clearly this suggests the provision for visitor scooter parking should also be considered.

12.10.6. Building 4 was an example of a store added to an existing scheme which was inadequate in all respects. Storage capacity was woefully low, leading to residents parking in the adjacent escape stair. Access to the store was extremely poor in terms of accessibility, inappropriate ironmongery, door size and operation with the fire safety compromised by the store being constructed in front of the existing fire escape stair and final exit door. Such an arrangement does not comply with the RRO. Clearly such additions need to be carefully considered and designed to a clear set of requirements.

12.11. Objective 2 Instruction 2: Conclusion

12.11.1. The usage of scooters to maintain independence for many residents was evident in the buildings visited. The research conducted in this objective has provided evidence which, although limited, suggests benefits of providing dedicated storage for mobility scooters which is suitably fire protected. Where stores have insufficient capacity or are difficult to use, this can lead to the fire safety of the building, being compromised, such as with store doors being wedged open, damage to fire doors within the building due to scooters being taken through the buildings and stored in corridors or flats.

12.11.2. A number of design features were identified that are considered to improve the usability of the storage provided. However, evidence collected to the actual benefits achieved was anecdotal from both residents and management. Although not exhaustive, these included the following features;

- Having sufficient capacity may reduce the number of scooters parked in flats and corridors.
- Defined scooter spaces with markings on the floor optimises usage within the store preventing disorganised parking.
- Ease of access from inside and outside the building optimises use for residents, although needs to be separated from the primary escape route.
- Bright and well-lit stores with robust finishes would reduce the potential for damage to fire integrity or door and improve safety for residents.
- Accessibility and access features on all doors would reduce damage to fire doors and improve visual connection into the store in the event of a fire.
- Well-designed charging facilities including avoidance of cable trip hazards for resident's safety.
- Controls to limit the time when charging can take place could reduce risk of fire when residents are asleep at night.
- Warden call point to enable residents to alert staff in the event of an emergency.

12.11.3. Nearly all of the fire performance design features gathered from the various guides covered in 12.3.4 earlier were seen, although not consistently at every site. These included the following;

- Fire resisting enclosures such as walls and ceilings.
- Ease of access from outside the building for the Fire Brigade.

- Fire doors leading to internal corridors with vision panels and self-closers.
- Fire alarm detection/warning
- Fire suppression systems

12.11.4. Fire performance design features from the guides which were not seen on the visits included the following;

- Controlling of charging time, as recommended in the NFCC Mobility scooter guidance.
- Explicit management procedures around maintenance of scooters.

12.11.5. Other fire features which were not covered by the guides but were evident included the following;

- Natural smoke ventilation provided by power open external store door activated on fire alarm activation (building 1).
- Illuminated fire escape signs inside the scooter store (building 5).

12.11.6. Well sited and properly designed mobility scooter stores of sufficient capacity and robust fire precaution would have the following benefits;

- Easy use of mobility scooters provides social and economic benefits to those with physical disabilities
- Secure storage where the fire risk from mobility scooter storage is contained.
- External doors to store, provide ease of access for residents and Fire Brigade alike
- Allow access to internal communal facilities for those who can't walk from their flat
- Charging which can be switched off at night/controlled to reduce potential fire risk may be of benefit but would require further research to justify.
- Fire-protected storage reduces risk of smoke and fire spread within the building in the event of a fire
- Escape routes within the building kept clear of mobility scooters
- Ventilation of dedicated stores allowing effective smoke clearance by the Fire Brigade may be of benefit but would require further research to justify.
- Early warning from fire alarm and fire suppression

12.11.7. The finer detail in relation to the approach to design and fire protection would warrant further research.

13. Bibliography

ABCD, Building Classifications, Understanding the NCC (Australian Building Codes Board, 2020).
ArupFire, Sprinklers for Safer Living: The Benefits of Automatic Fire Suppression Systems in Residential Care Premise (BAFSA, 2010).
Bhogal, Healthcare Development Opportunities Research 2020 (Knight Frank, 2020)
BRE Fire and Security, Cost benefit analysis of residential sprinklers for Wales (BRE Global, 2013).
BRE Group, BRE Trust Project: Heat release and smoke production from burning mobility scooters (BRE, 2015)
BRE Group, Compartment sizes, resistance to fire and fire safety project, Work stream 5 – Sprinkler provisions, BD2887 (BRE Trust, 2015)
Bryant and Preston, Focus on trends in fires and fire-related (Home Office, 2017).
BSI, British Standard Code of Practice, CP 3 : Chapter IV : Part I : 1971 (British Standards Institute, 1971, incorporating amendments issued January 1972 (AMD 851), January 1973 (AMD 1077), Feb 1976 (AMD 1889) and August 1978 (AMD 2708))
BSI, BS5839-6: 2019+A1:2020. Fire detection and fire alarm systems for buildings - Code of practice for the design, installation, commissioning and maintenance of fire detection and fire alarm systems in domestic premises (BSI, 2020)
BSI, BS 9251:2021 – TC : Fire sprinkler systems for domestic and residential occupancies. Code of practice. (BSI, 2021).
BSI, BS9991: 2015 Fire Safety in the design, management and use of residential buildings (BSI, 2015).
BSI, BS9999: 2020 Code of practice for fire safety in the design, management and use of buildings (BSI, 2020).
BSI, Fire safety in the design, management and use of residential buildings – Code of practice (BSI, 2011).
BSI, PD 79474-6: 2019 Application of fire safety engineering principles to fire safety design of buildings — Part 6: Human factors: Life safety strategies — Occupant evacuation, behaviour and condition (Sub-system 6) (BSI, 2019).
Building Regulations, Approved Document B Part B Volume 1 & Volume 2 (HM Government, 2010).
Building Regulations, Approved Document B Part B Volume 1 (HM Government, 2010).
Building Regulations, The Building (Amendment) Regulations 2018 (HM Government, 2018).
Buxton, P, (ed.), Metric Handbook, Planning and Design Data, Seventh Edition (Routledge, 2022)
Cassidy, et al.,The older adult: Associated fire risks and current challenges for the development of future fire safety intervention strategies. Interflam 2019: Human Behaviour in Fire. (Ulster University, 2020).
Coty, et al., Home fire safety beliefs and practices in homes of urban older adults (Geriatric Nursing, 2015).
Cronkleton, What is the Average Walking Speed of an Adult? (Healthline, 2019).
Crowder and Charters, FB 52 Evacuating Vulnerable and Dependent People from Buildings in an Emergency (BRE Trust, 2013).
Decreto-Lei n.º 1532/2008 (Diário da República n.º 250/2008, Série I de 2008-12-29)
Decreto-Lei n.º 224/2015 (Diário da República n.º 198/2015, Série I de 2015-10-09)
Dutch Burns Foundation, Fire safety and the ageing population (Netherlands Institute for Public Safety, 2016).
Extract from the CFPA Europe website: https://cfpa-e.eu/national-regulations/regulations-portugal/
Florida Building Code 2020, 7th Edition: Chapter 3: Use and Occupancy Classification (International Code Council, 2020)
Folk, et al., Emergency Egress for the Elderly in Care Home Fire Situations (Arup & York University, 2020).
Harpur, et al., An Investigation into the Circumstances Surrounding Elderly Dwelling Fire Fatalities and the Barriers to Implementing Fire Safety Strategies among this Group . Fire Safety Science-Proceedings Of The Eleventh International Symposium, (pp. 1144-1159). (Ulster University, 2014).

Harwood, Rising investment to underpin increase in development of seniors housing (Knight Frank, 2020).
HM Government, Detailed analysis of fires attended by fire and rescue services, England, April 2018 to March 2019 (Home Office, 2019).
HM Government, Detailed analysis of fires attended by fire and rescue services, England, April 2021 to March 2022 (Home Office, 2022).
HM Government, English Housing Survey Housing for Older People Report, 2014-15 (Ministry of Housing, Communities & Local Government, 2006).
HM Government, Fire Safety Risk Assessment Residential Care Premises (Department for Communities and Local Government, 2006).
HM Government, Fire Safety Risk Assessment: Sleeping (The Stationery Office, 2006)
HM Government, Learning Lessons from Real Fires: Findings from Fatal Fire Investigation Reports. (Department for Communities and Local Government, 2006).
Hodkinson, et al., The Fire Risks of Purpose-Built Blocks of Flats: an Exploration of Official Fire Incident Data in England. Interim Research Findings. (British Automatic Fire Sprinkler Association, 2021).
Home Office (HM Government, 2013). Retrieved from Fire and rescue incident statistics: https://www.gov.uk/government/collections/fire-statistics-monitor
Home Office (HM Government, 2021). Official Statistics, Fire statistics incident level datasets. Retrieved from GOV.UK: https://www.gov.uk/government/statistics/fire-statistics-incident-level-datasets
Home Office Fire and Emergency Planning Department, Draft guide to fire precautions in existing residential care premises (National British Standards, 1983)
https://www.gov.uk/government/statistics/fire-statistics-incident-level-datasets
Housing LIN, Design Principles for Extra Care Housing (3rd Edition), Factsheet no 6. (Housing LIN, 2020)
Hu, et al., Projections of Demand and Expenditure on Adult Social Care 2015 to 2040 (LSE, 2018).
Koo, Fire Experiments on mobility scooters protected by sprinklers (BRE Global, 2016).
LFB, Care Home Fires and Specialised Housing Fires redacted, 2014 - 2019, (LFB, 2020)
LFB, Compartmentation Issues, For periods Quarter 3 2018/19, (LFB, 2020);
Meacham, et al., Chapter 75 Building Fire Risk Analysis, SPFE Handbook, Fifth Edition (SPFE, 2016).
National Construction Council (NCC), Building Code of Australia 2019 Volumes 1 and 2, Amendment 1 (Australian Building Codes Board, 2019).
National Fire Chiefs Council, Fire Safety in Specialised Housing (NFFC, 2017).
National Fire Chiefs Council, Mobility Scooter Guidance for Residential Buildings (NFCC, 2018).
New Zealand Government, C/AS1 Commentary for Acceptable Solutions for Buildings other than Risk Group SH (Ministry of Business, Innovation and Employment, New Zealand, 2019).
New Zealand Government, Commentary for Acceptable Solutions C/AS1 to C/AS7 (Ministry of Business, Innovation and Employment, New Zealand, 2013).
New Zealand Government, The Building Regulations 1992, Reprinted 2017 (Ministry of Business, Innovation and Employment, 2017).
Office for National statistics, 2011 Census User Guidance Glossary of Terms (Office for National statistics, 2014).
Rahouti, et al., Human behaviour during a healthcare facility evacuation drills: Investigation of pre-evacuation and travel phases (Safety Science, 129, 2020).
Royal Commission into Aged Care Quality and Safety, Interim Report (Royal Commissions, 2019).
Runefors et al., The effectiveness of specific fire prevention measures for different population groups. Fire Safety Journal 91, 1044-1050. (Lund University, 2017).
Runefors, et al., Factors contributing to survival and evacuation in residential fires involving older adults in Sweden. Fire Safety Journal 122. (Lund University, 2021).
SABS, SANS 10400-A:2010 Edition 3, South African National Standard, The Application of the National Building Regulations Part A: General principles and requirements (SABS Standards Division, Nov 2010).
SABS, SANS 10400-T:2010 Edition 3, South African National Standard, The Application of the National Building Regulations Part T: Fire Protection (SABS Standards Division, Mar 2011).

Schimpl, et al., Association between walking speed and age in healthy, free-living individuals using mobile accelerometry — A cross-sectional study (PLoS One, 2011).

Scottish Government, Fire safety guidance for care homes (The Scottish Government, 2014).

Scottish Government, Practical Fire Safety Guidance for existing Specialised Housing and similar premises (The Scottish Government, 2020).

Shields and Proulx, The science of human behaviour: past research endeavours,current developments and fashioning a research agenda, (pp. 95-114).(Sixth International Symposium on Fire Safety Science, IAFSS, 2000).

Taylor, An Exploration of Causal Factors in Unintentional Dwelling Fires. Risk Management 14, no. 2, 109–125. (Springer, 2012).

The Regulatory Reform (Fire Safety) Order 2005 (HM Government, 2005).

Thompson, et al., A review of the literature on human behaviour in dwelling fires. (Safety Science, 303-312, 2018).

14. Appendices

Appendix 1 Quantitative Survey

Appendix 2 Case Studies

Appendix 3 Reference Documents

Appendix 4 Guidance Document Comparison

Appendix 5 Literature Review by Innovation Fire

Appendix 1 Quantitative Survey

This appendix sets out some of the results of an analysis of responses from an online survey carried out by PRP entitled "Fire Safety within Specialised Housing and Care Homes".

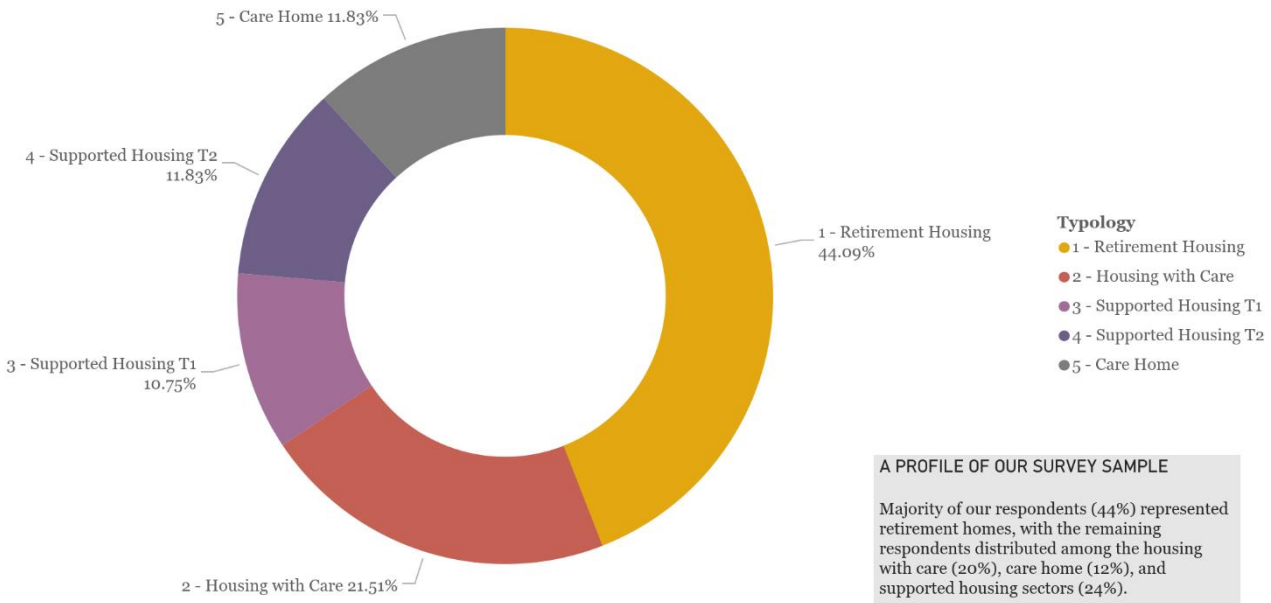
The survey questionnaire was sent out to a range of care providers in England, with responses received from 102 building managers. A total of 93 respondents completed the majority of survey questions.

This qualitative analysis is aimed at characterising the current landscape surrounding the following typologies:

1. Retirement Housing
2. Housing with Care
3. Supported Housing Type 1
4. Supported Housing Type 2
5. Care Homes.

Through this analysis we hope to better understand the differences between these typologies, how they operate, and similarities and differences in terms of how they deal with fire safety.

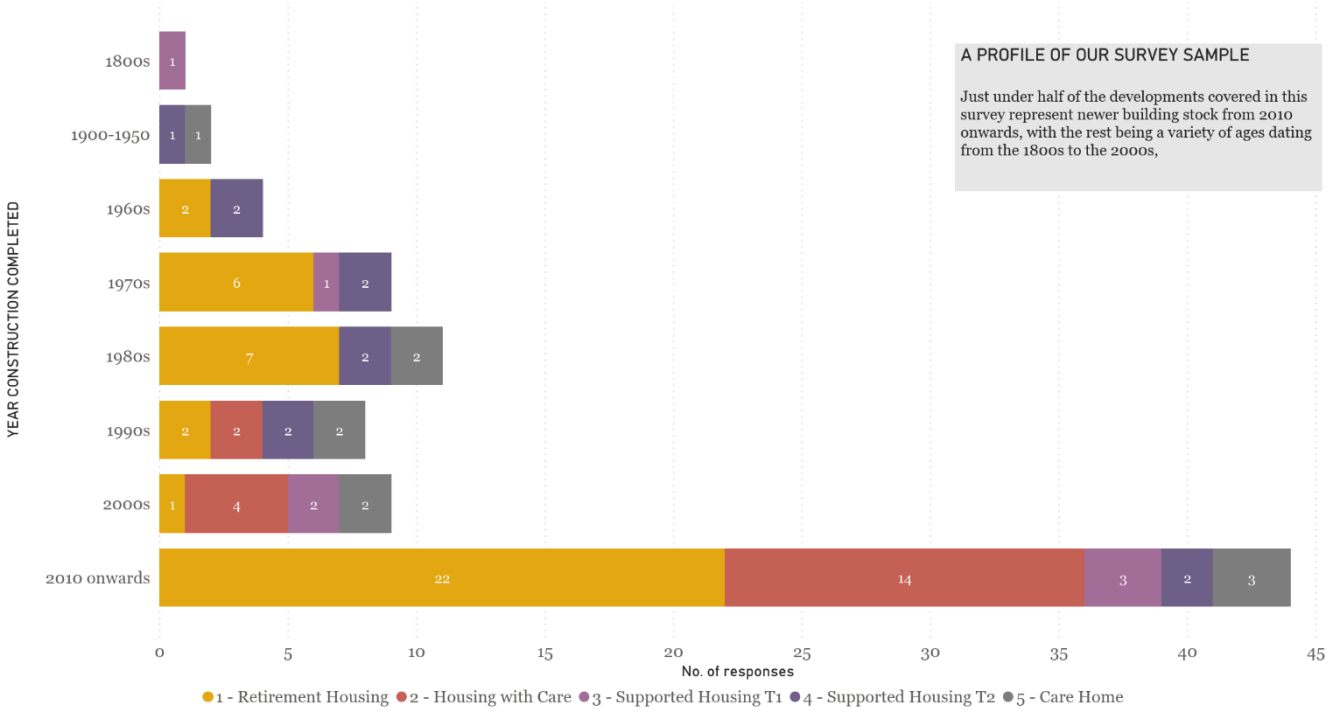
TYPOLOGIES INCLUDED IN THE STUDY



A PROFILE OF OUR SURVEY SAMPLE

Majority of our respondents (44%) represented retirement homes, with the remaining respondents distributed among the housing with care (20%), care home (12%), and supported housing sectors (24%).

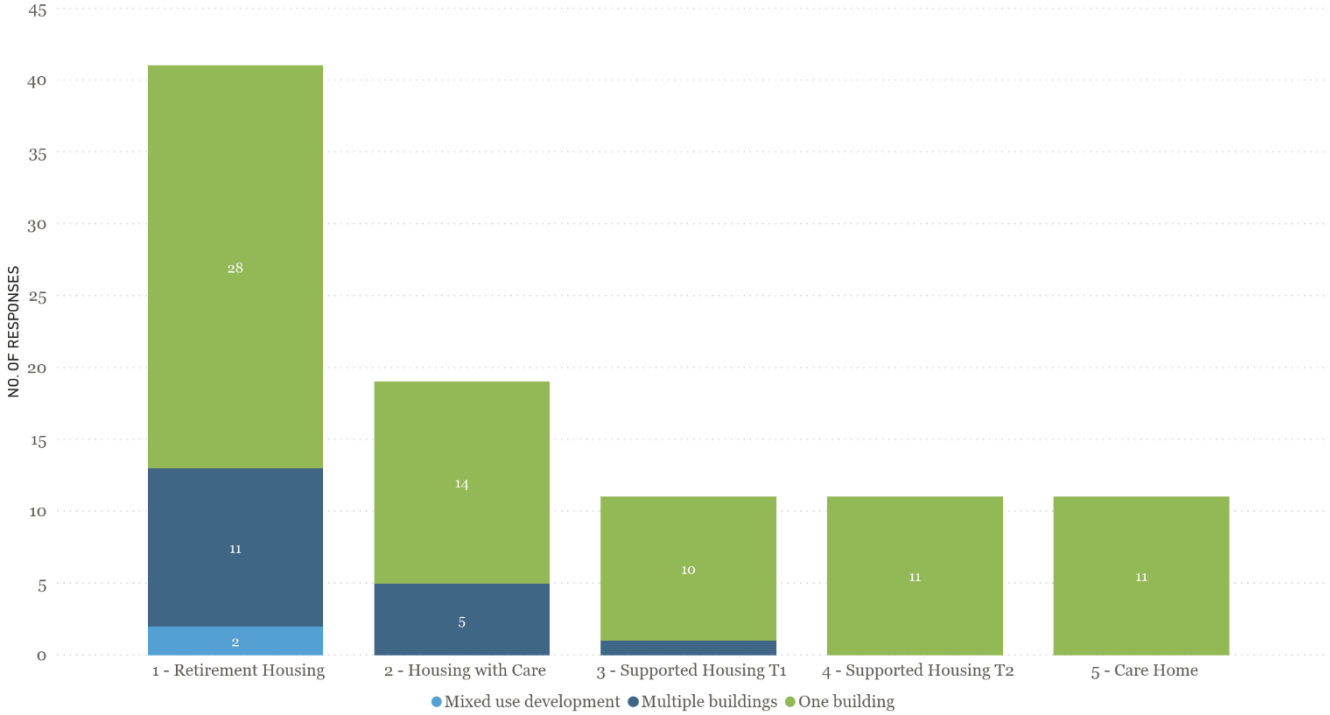
YEAR OF CONSTRUCTION



A PROFILE OF OUR SURVEY SAMPLE

Just under half of the developments covered in this survey represent newer building stock from 2010 onwards, with the rest being a variety of ages dating from the 1800s to the 2000s,

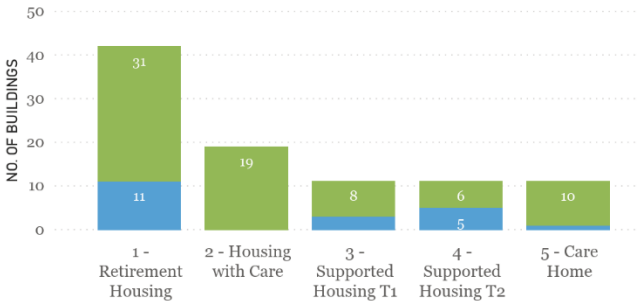
DEVELOPMENT TYPES BY TYPOLOGY



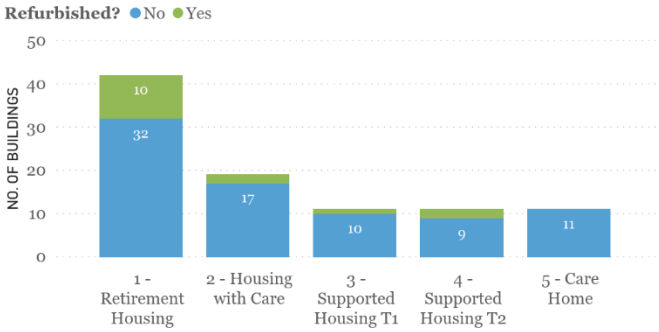
WHAT DEVELOPMENT TYPES DOES THE SURVEY COVER?

Most of the buildings covered by the survey are purpose built buildings. A small proportion of retirement houses, housing with care facilities, and supported housing facilities have also been either refurbished and/or converted from another use.

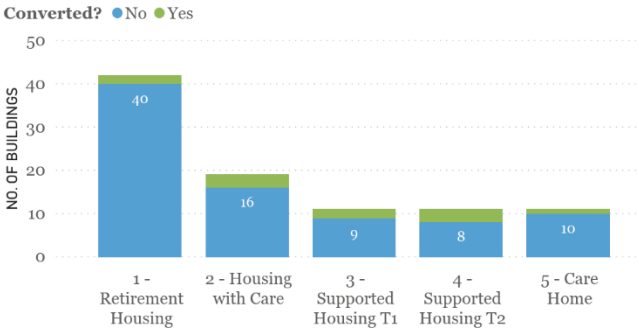
PURPOSE BUILT BUILDINGS



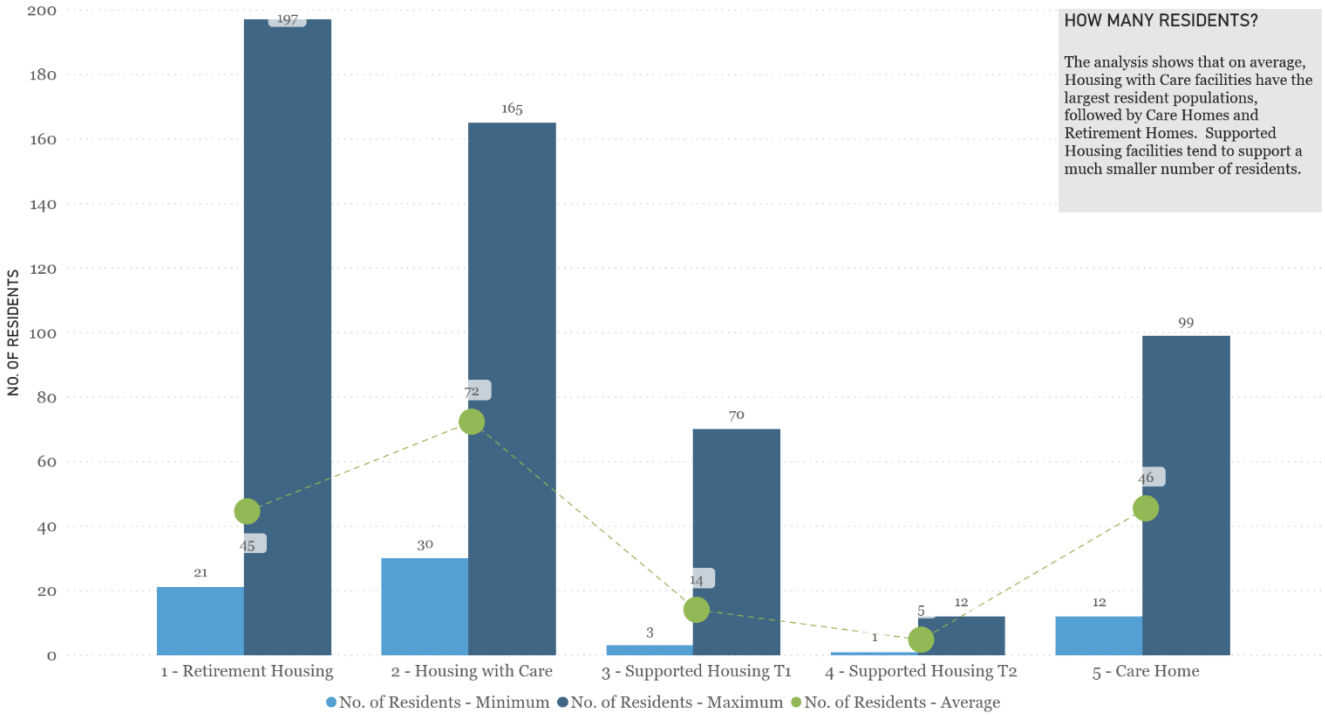
REFURBISHED BUILDINGS



CONVERTED BUILDINGS



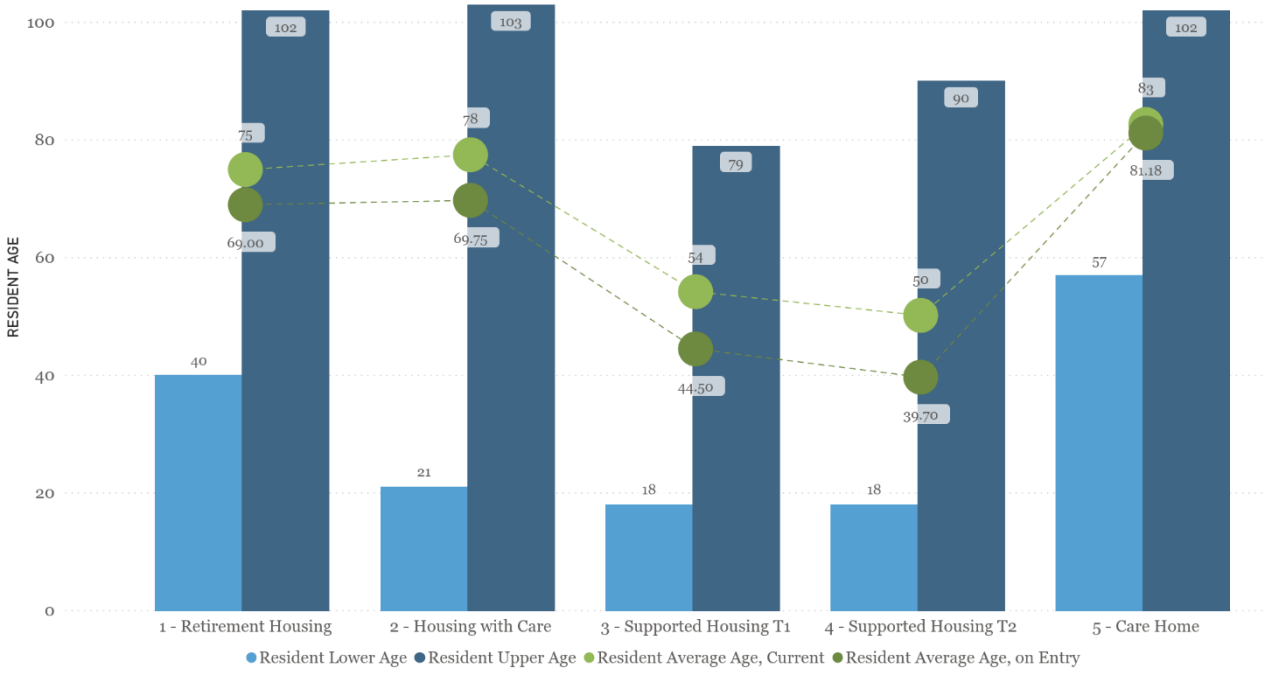
NO. OF RESIDENTS BY DEVELOPMENT TYPE



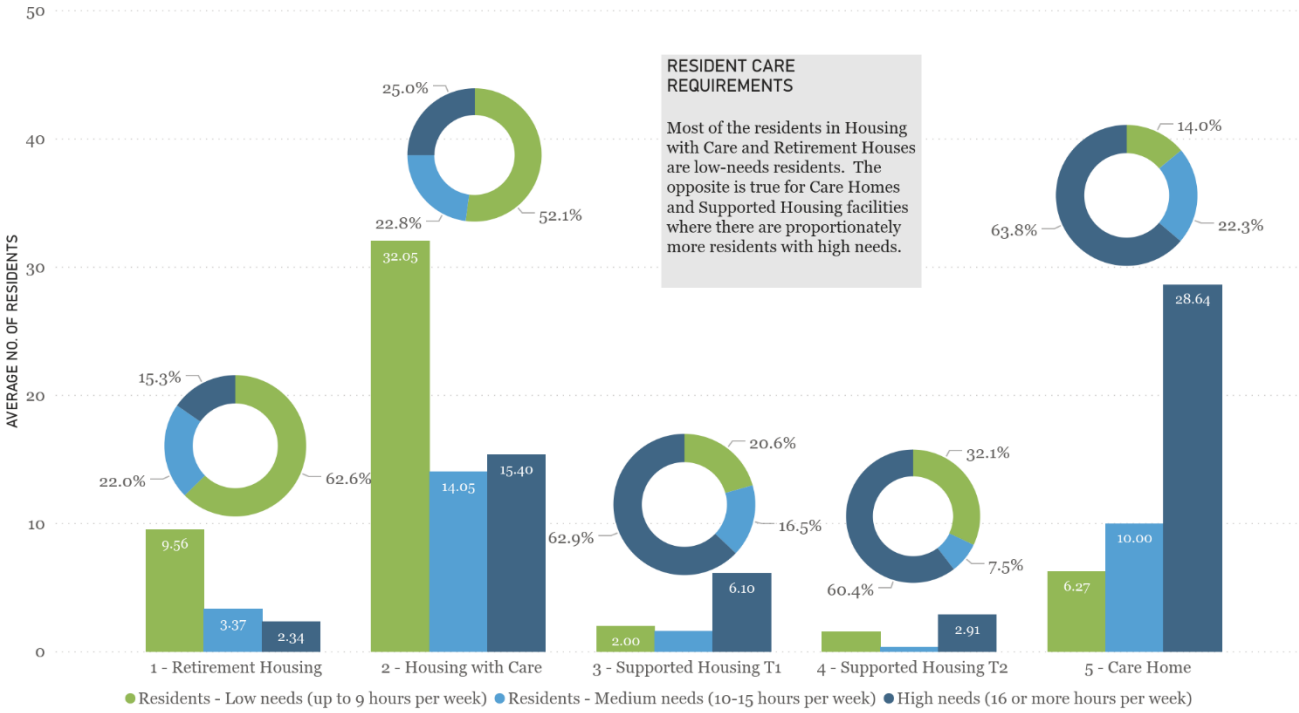
HOW MANY RESIDENTS?

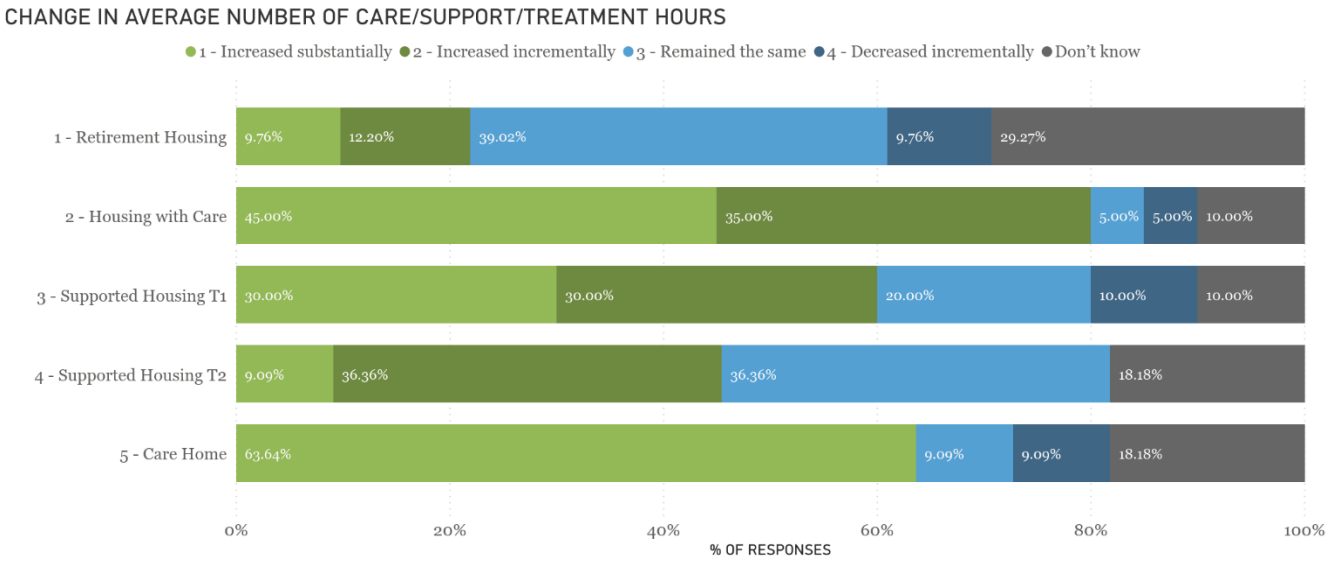
The analysis shows that on average, Housing with Care facilities have the largest resident populations, followed by Care Homes and Retirement Homes. Supported Housing facilities tend to support a much smaller number of residents.

RESIDENT AGE



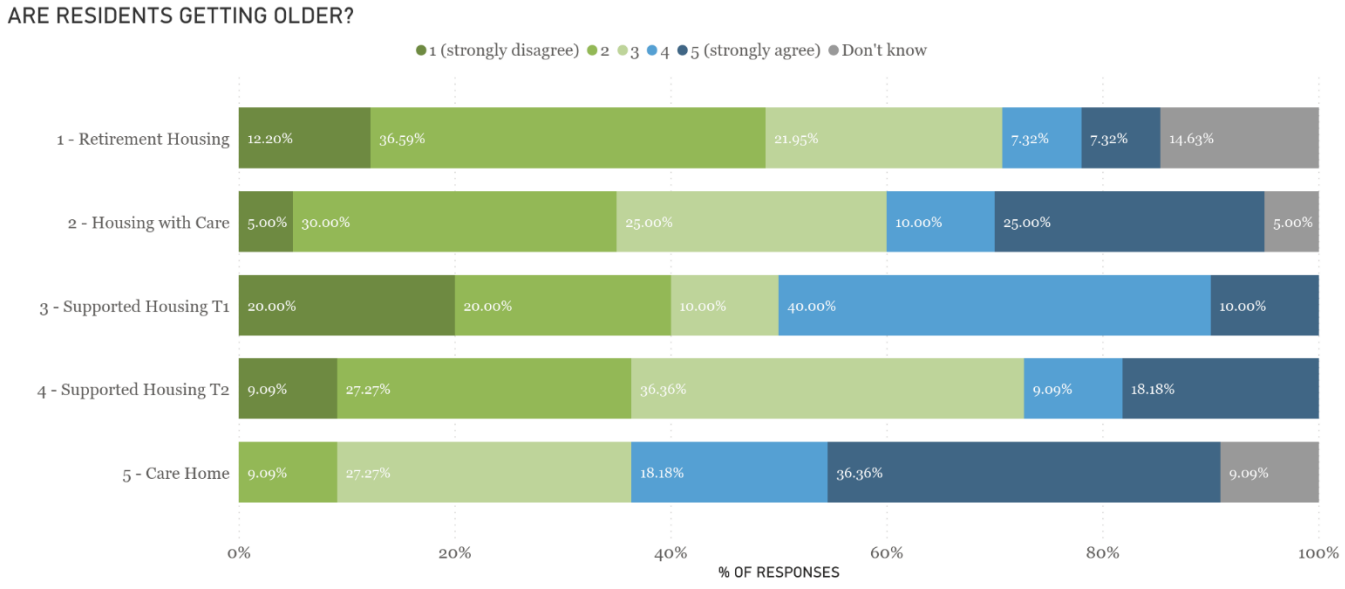
RESIDENTS WITH CARE/SUPPORT/TREATMENT NEEDS





RESIDENT CARE REQUIREMENTS - TRENDS

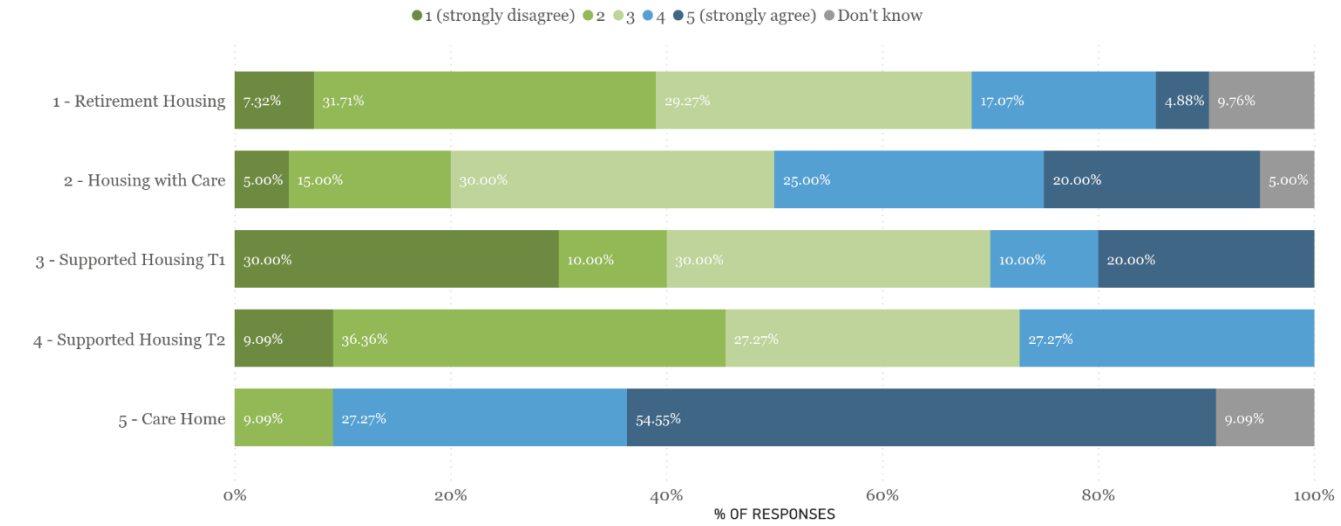
Many of our respondents for retirement homes believe that there has been no change in resident care requirements for that sector, although a significant number of respondents responded 'Don't know'. The Housing with Care and Care Home sectors believe that the care requirements have increased either incrementally or substantially in recent years. For supported housing T1, the general opinion, although not as strongly dominant, is that care needs have increased, while for supported housing T2 it tends towards the care requirements having remained the same, with some incremental increases.



RESIDENT AGE

Most of the respondents for the retirement housing and supported housing T2 sectors tended to disagree that residents were getting older, while most of the respondents in the supported housing T1 and care home sectors tended to agree that their residents were getting older.

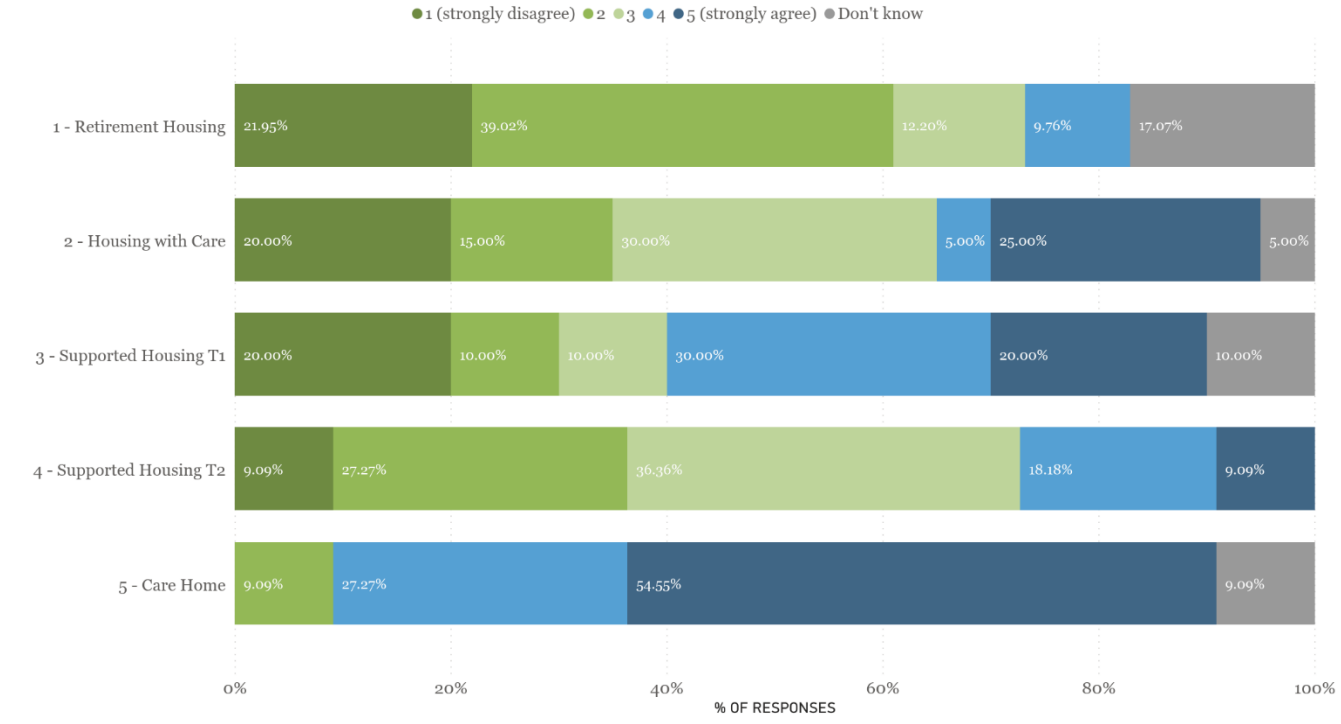
IS THE LEVEL OF FRAILTY INCREASING?



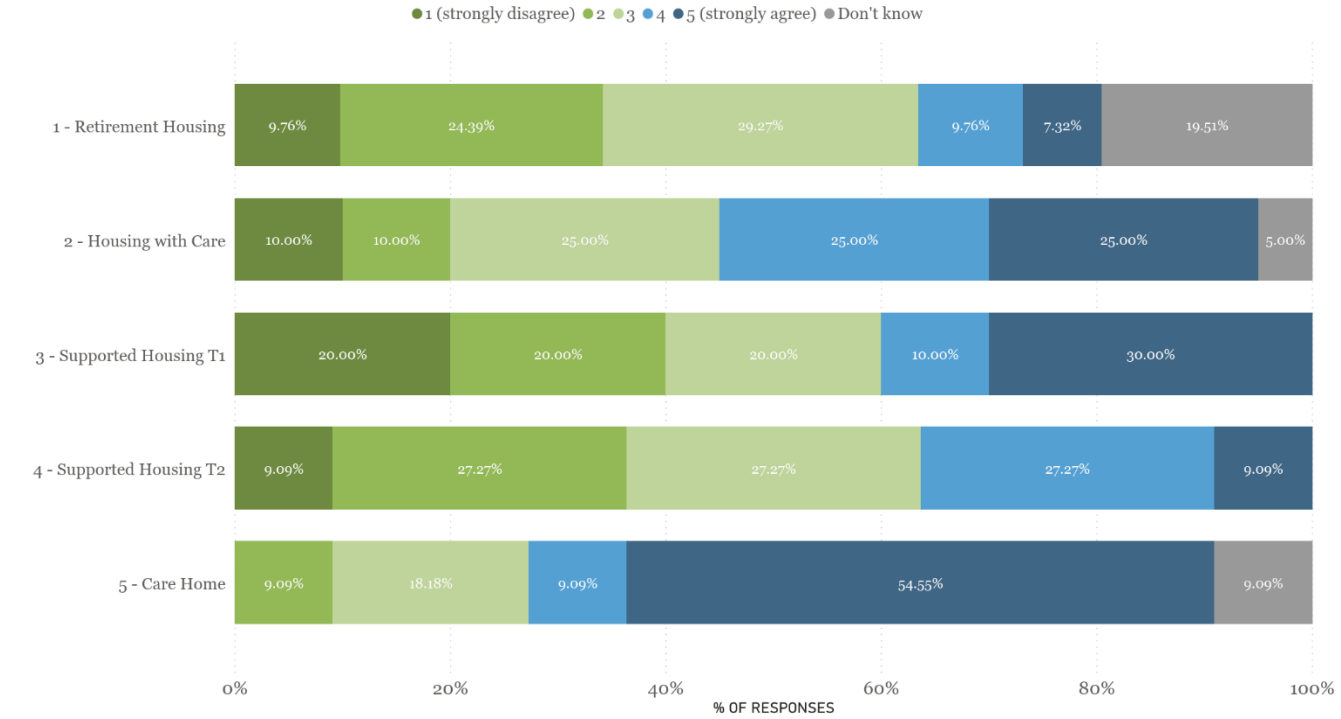
FRAILTY

Majority of the respondents in the care home sector strongly agreed that frailty was increasing in their sector, followed by housing with care. For all the other typologies, the picture is more split between the two ends of the spectrum.

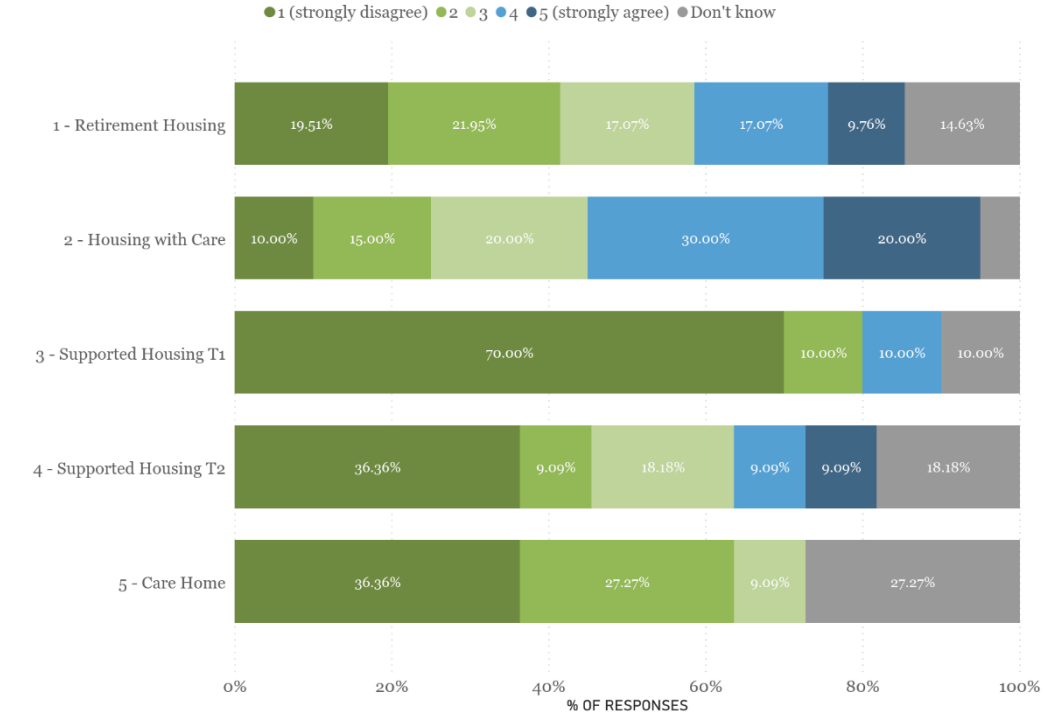
ARE RESIDENTS LESS ABLE TO SELF-EVACUATE?



ARE THEIR IMPAIRMENTS BECOMING MORE COMPLEX?

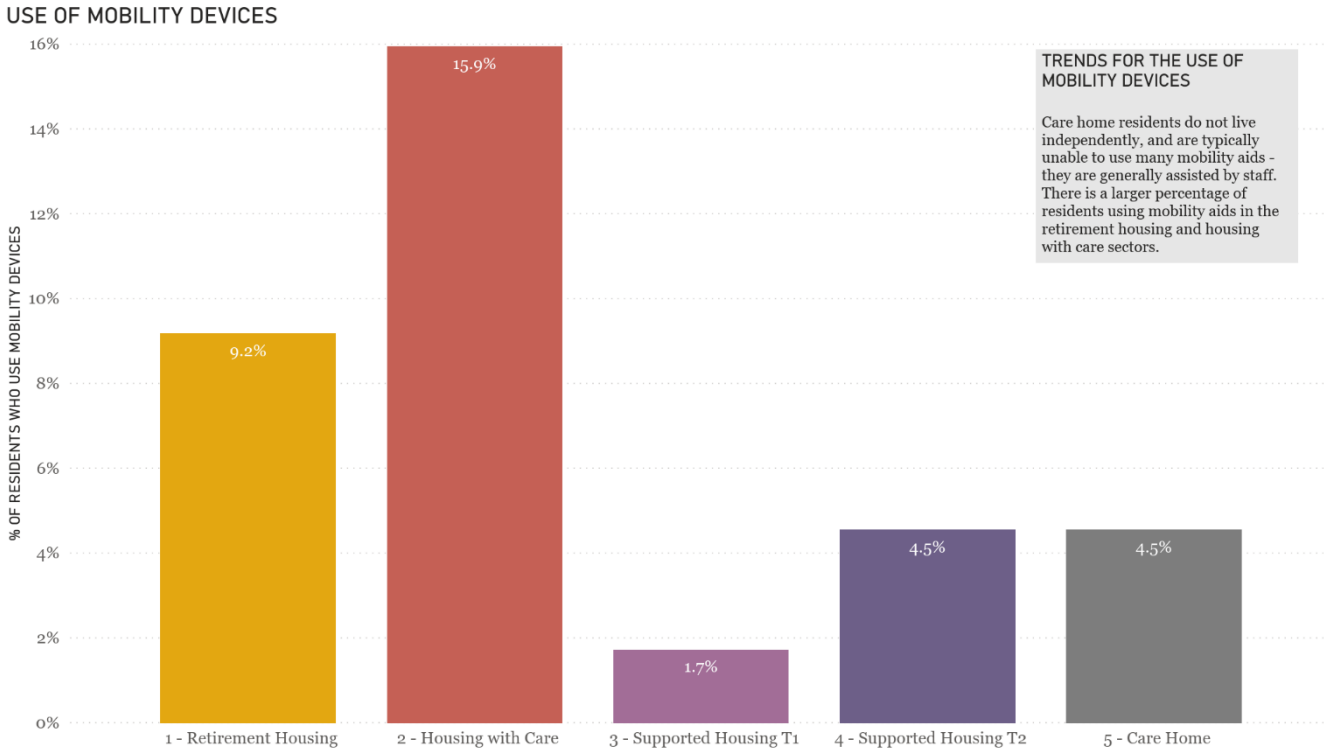


HAS THE USE OF MOBILITY DEVICES INCREASED?



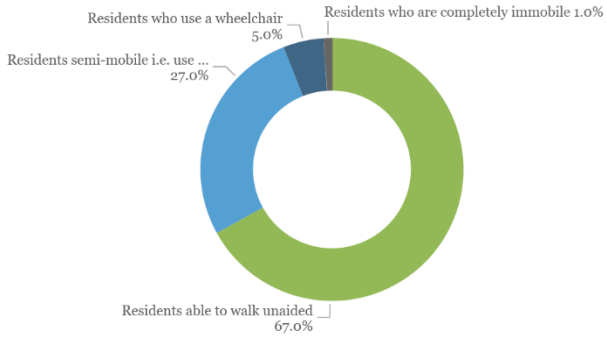
TRENDS FOR THE USE OF MOBILITY DEVICES

We would not expect to see the use of mobility devices increasing in care homes as these people are generally so frail that they are already using mobility aids. We are seeing an increase in housing with care sector.

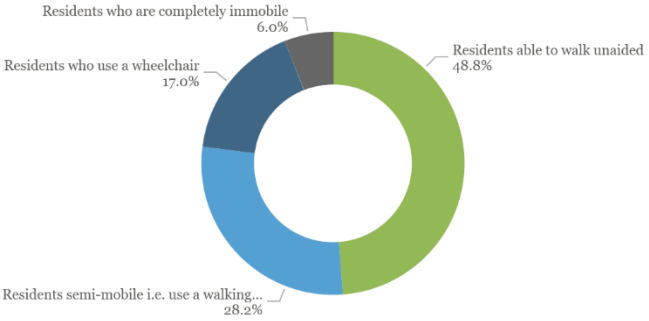

USE OF MOBILITY DEVICES
% OF RESIDENTS WHO USE MOBILITY DEVICES
16%
14%
12%
10%
8%
6%
4%
2%
0%
9.2%
15.9%
1.7%
4.5%
4.5%
1 - Retirement Housing
2 - Housing with Care
3 - Supported Housing T1
4 - Supported Housing T2
5 - Care Home
TRENDS FOR THE USE OF MOBILITY DEVICES
Care home residents do not live independently, and are typically unable to use many mobility aids - they are generally assisted by staff. There is a larger percentage of residents using mobility aids in the retirement housing and housing with care sectors.

MOBILITY

RETIREMENT HOUSING

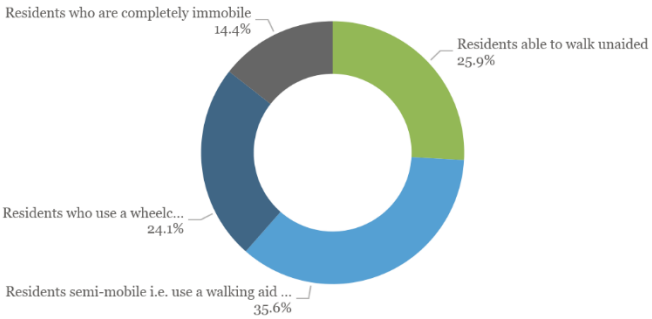


HOUSING WITH CARE

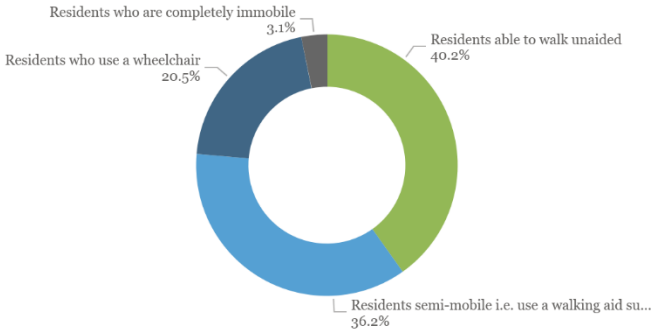


MOBILITY

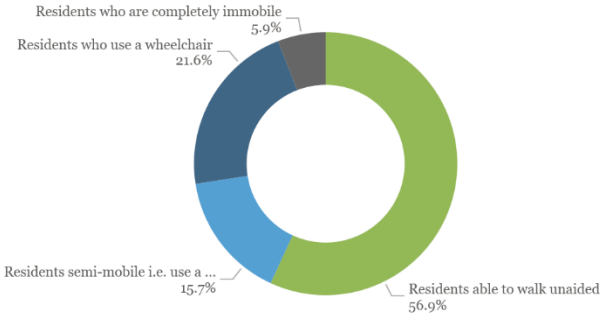
MOBILITY - CARE HOME



SUPPORTED HOUSING T1

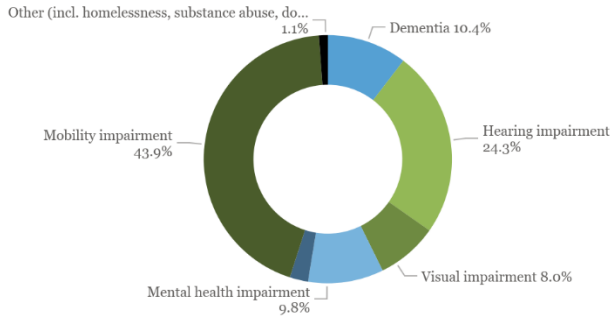


MOBILITY - SUPPORTED HOUSING T2

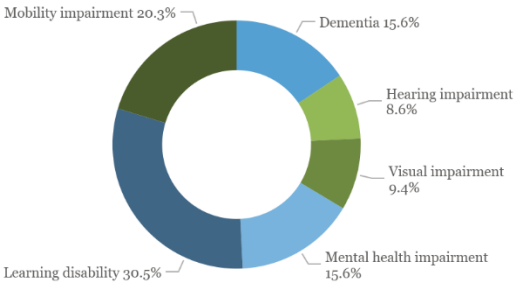


IMPAIRMENTS HINDERING ESCAPE

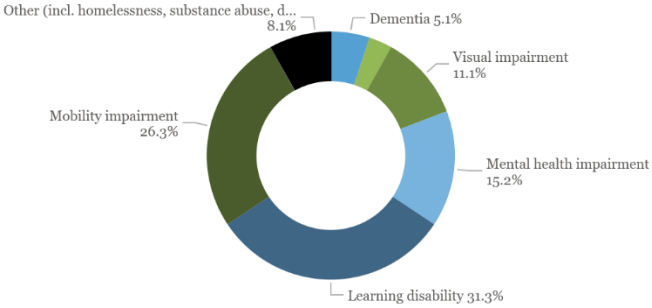
RETIREMENT HOUSING



SUPPORTED HOUSING T1

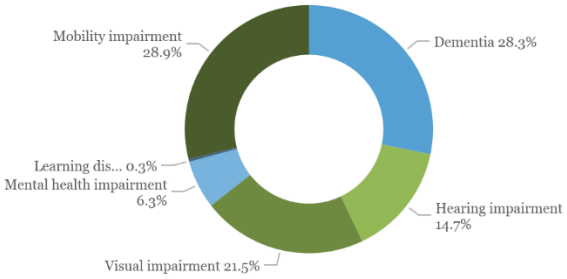


SUPPORTED HOUSING T2

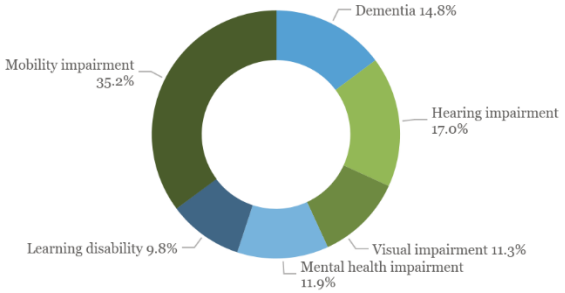


IMPAIRMENTS HINDERING ESCAPE

CARE HOME

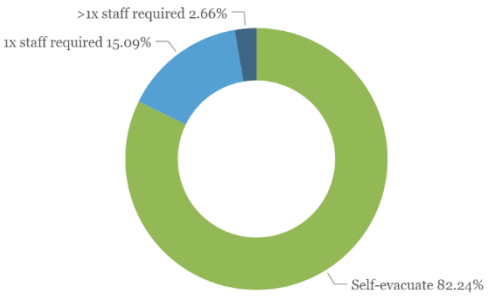


HOUSING WITH CARE

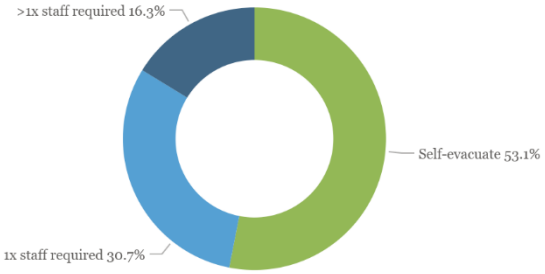


ASSISTANCE TO EVACUATE

RETIREMENT HOUSING

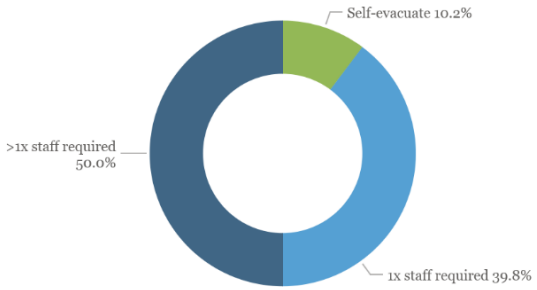


HOUSING WITH CARE

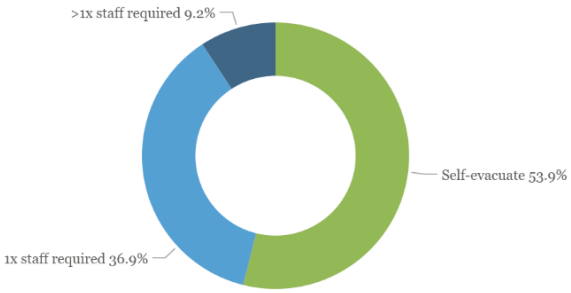


ASSISTANCE TO EVACUATE

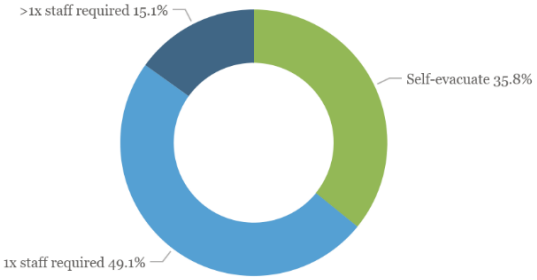
CARE HOMES



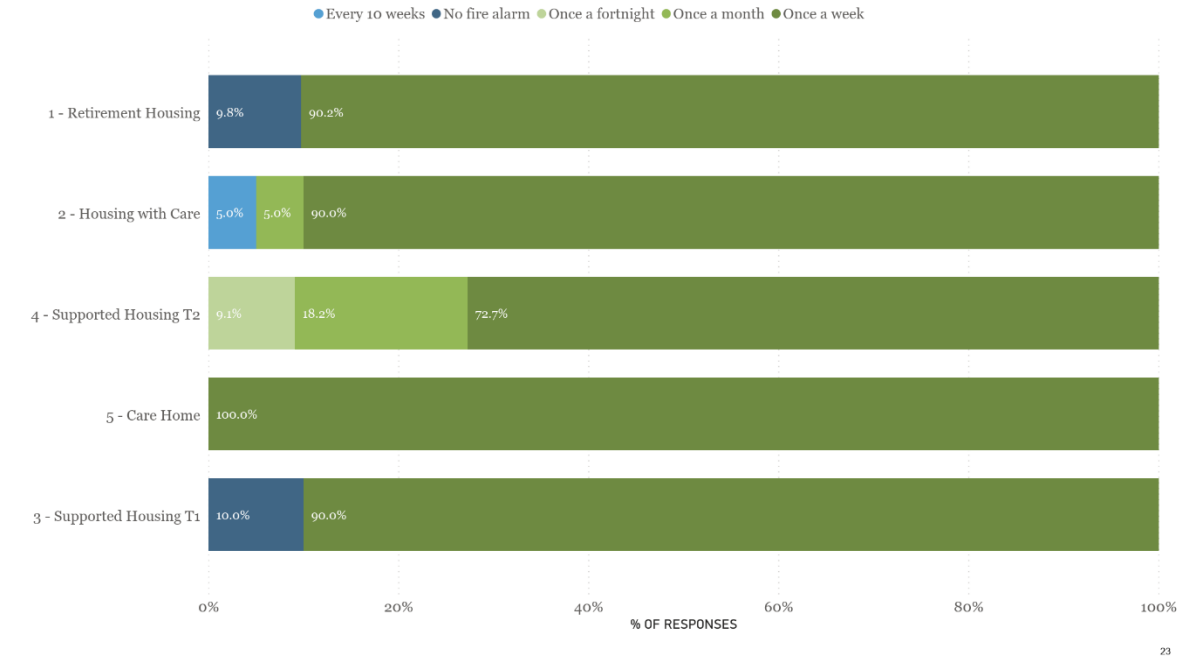
SUPPORTED HOUSING T1



SUPPORTED HOUSING T2

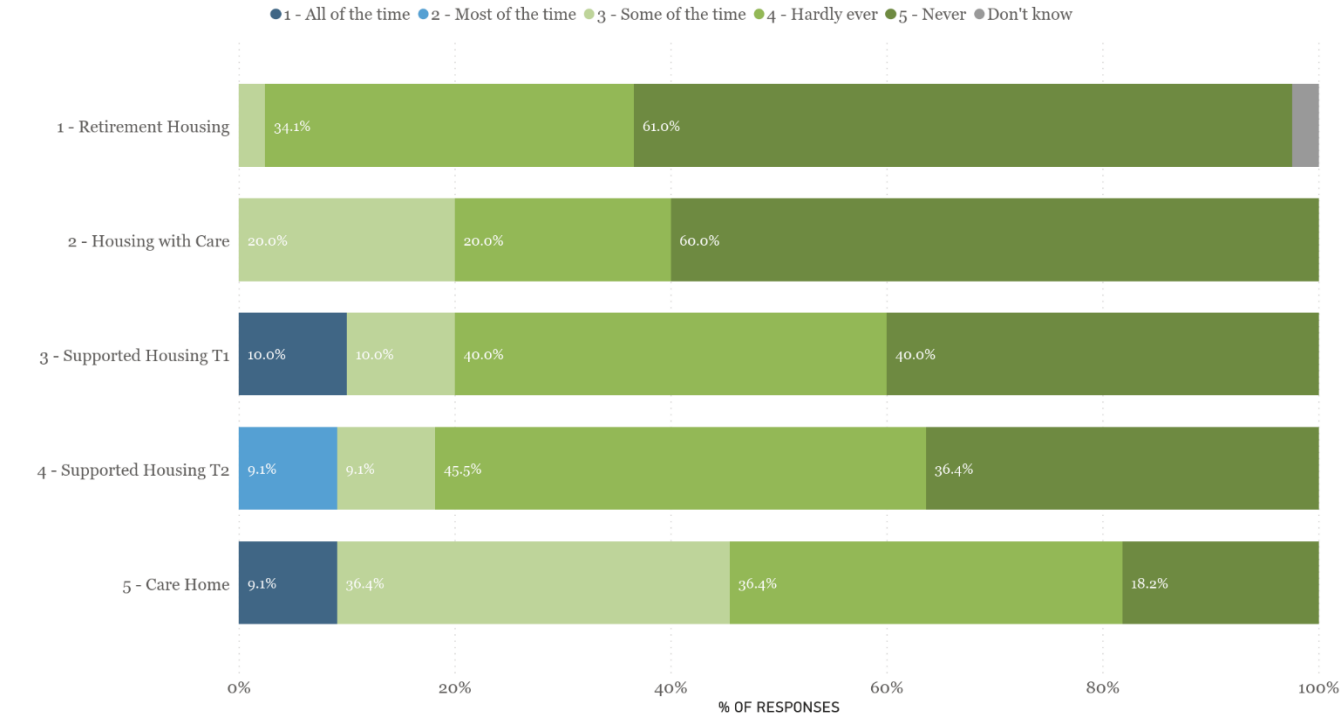


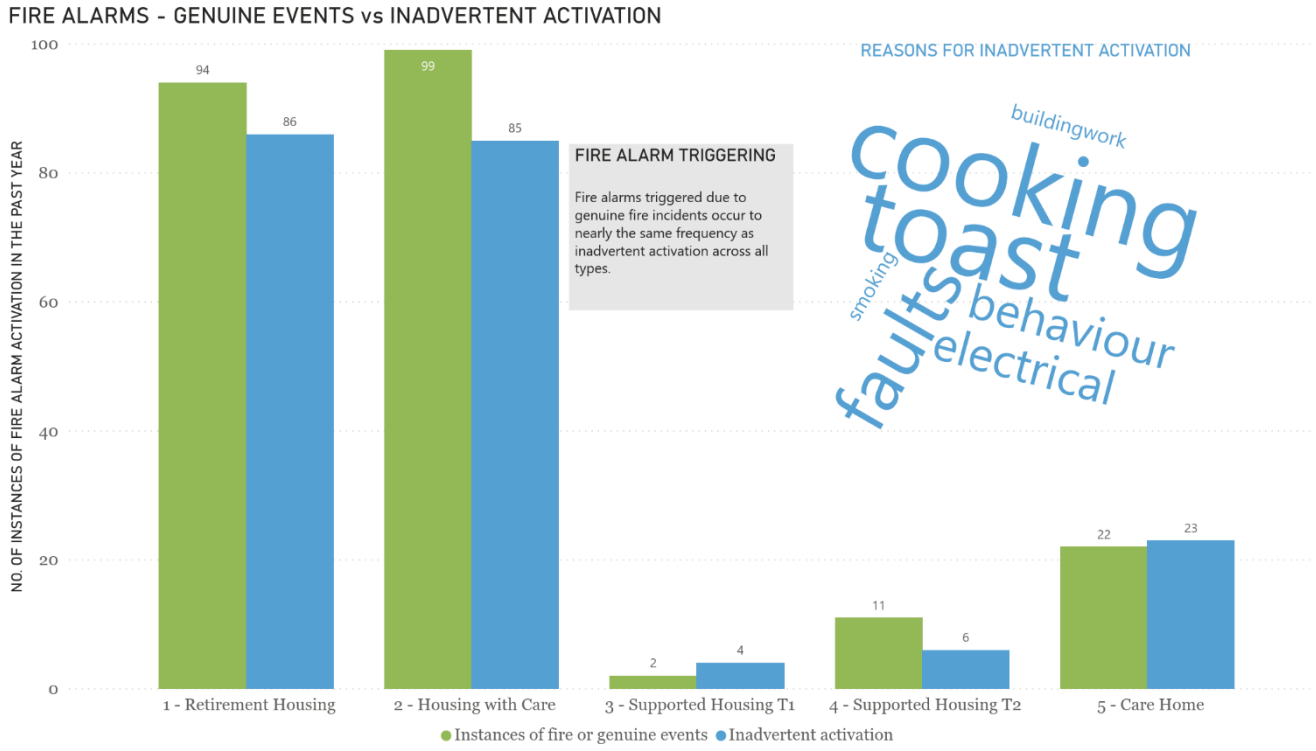
FREQUENCY OF FIRE ALARM TESTING

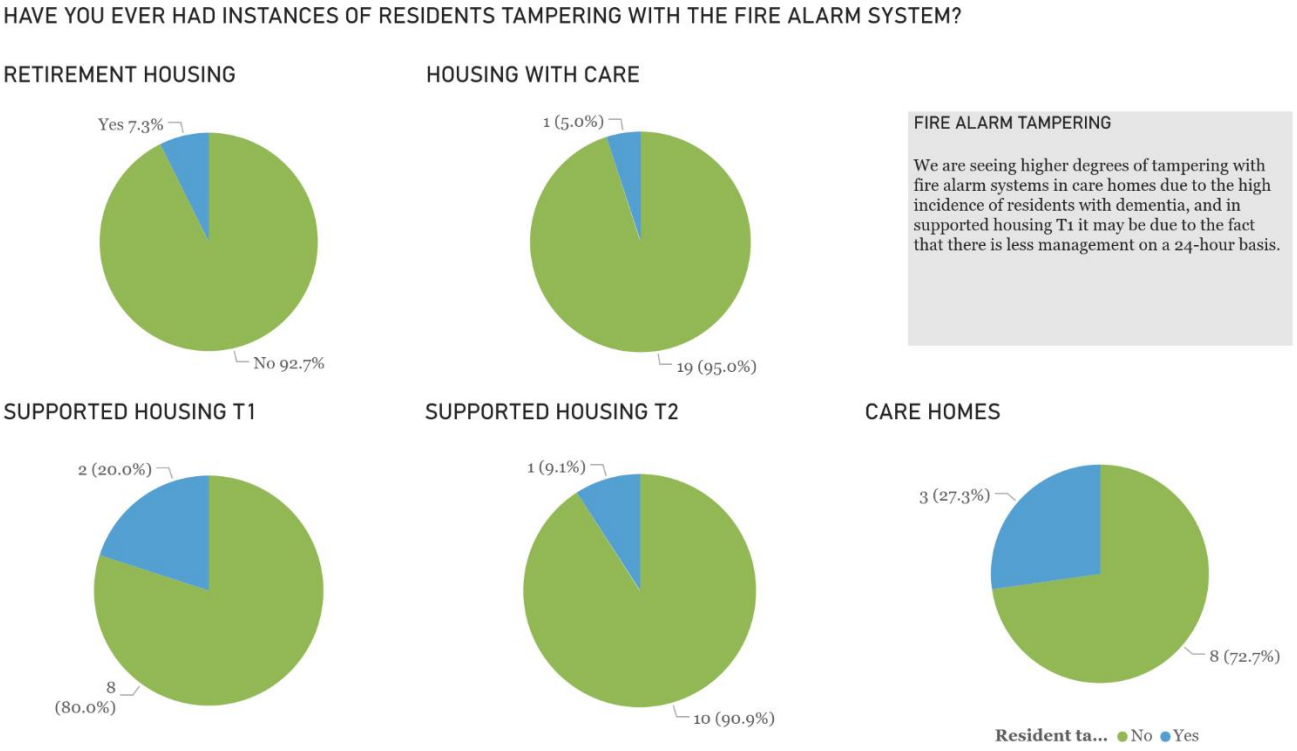


23

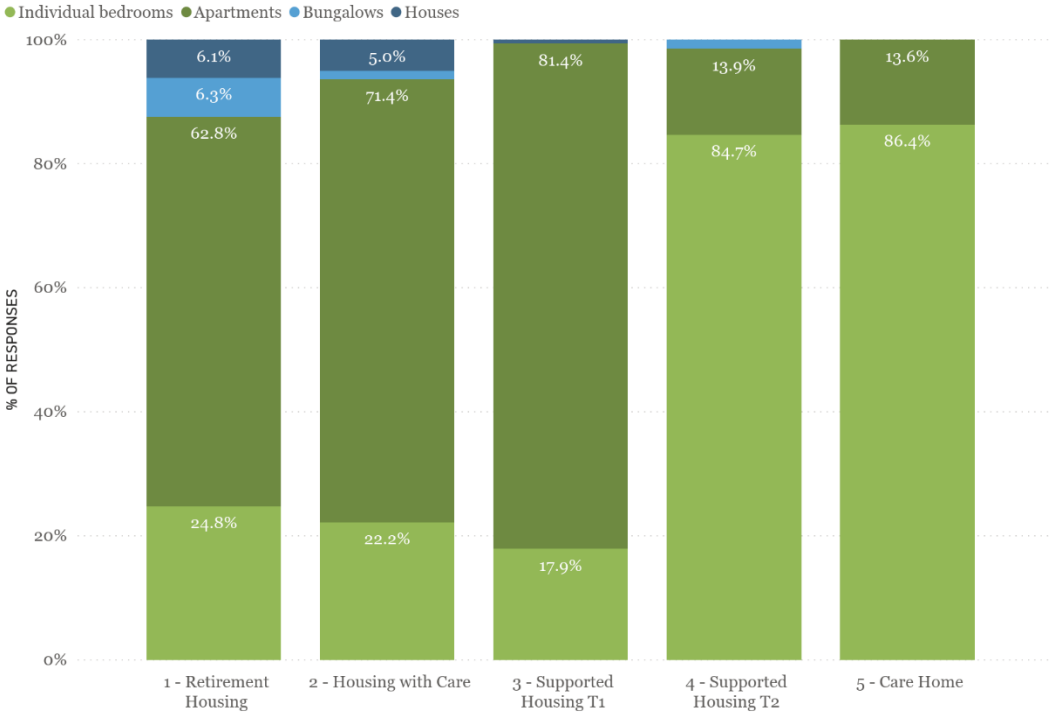
DOES FIRE ALARM TESTING CAUSE CONFUSION FOR THE RESIDENTS?




FIRE ALARMS - GENUINE EVENTS vs INADVERTENT ACTIVATION
NO. OF INSTANCES OF FIRE ALARM ACTIVATION IN THE PAST YEAR
100
80
60
40
20
0
94
86
99
85
2
4
11
6
22
23
1 - Retirement Housing
2 - Housing with Care
3 - Supported Housing T1
4 - Supported Housing T2
5 - Care Home
Instances of fire or genuine events
Inadvertent activation
FIRE ALARM TRIGGERING
Fire alarms triggered due to genuine fire incidents occur to nearly the same frequency as inadvertent activation across all types.
REASONS FOR INADVERTENT ACTIVATION
buildingwork
cooking
toast
smoking
behaviour
faults
electrical


HAVE YOU EVER HAD INSTANCES OF RESIDENTS TAMPERING WITH THE FIRE ALARM SYSTEM?
RETIREMENT HOUSING
Yes 7.3%
No 92.7%
HOUSING WITH CARE
1 (5.0%)
19 (95.0%)
FIRE ALARM TAMPERING
We are seeing higher degrees of tampering with fire alarm systems in care homes due to the high incidence of residents with dementia, and in supported housing T1 it may be due to the fact that there is less management on a 24-hour basis.
SUPPORTED HOUSING T1
2 (20.0%)
8
(80.0%)
SUPPORTED HOUSING T2
1 (9.1%)
10 (90.9%)
CARE HOMES
3 (27.3%)
8 (72.7%)
Resident ta...
No
Yes

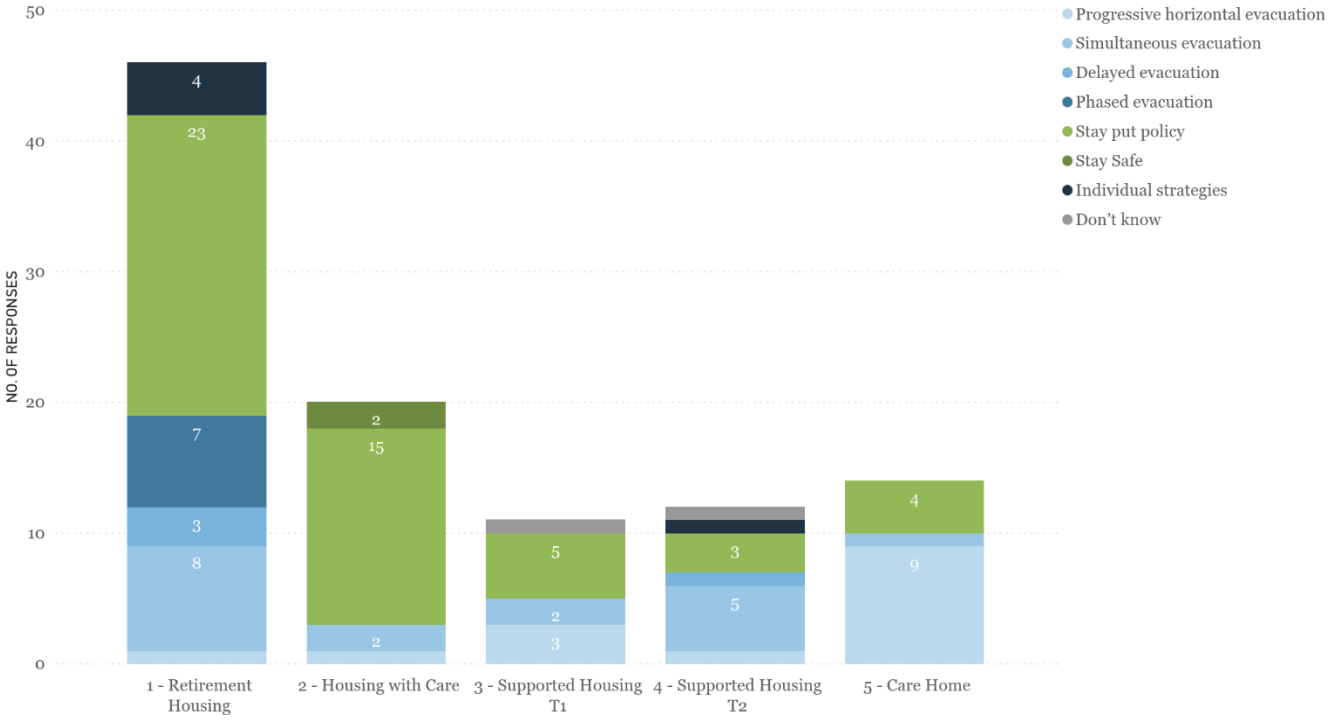
ACCOMMODATION TYPES BY TYPOLOGY



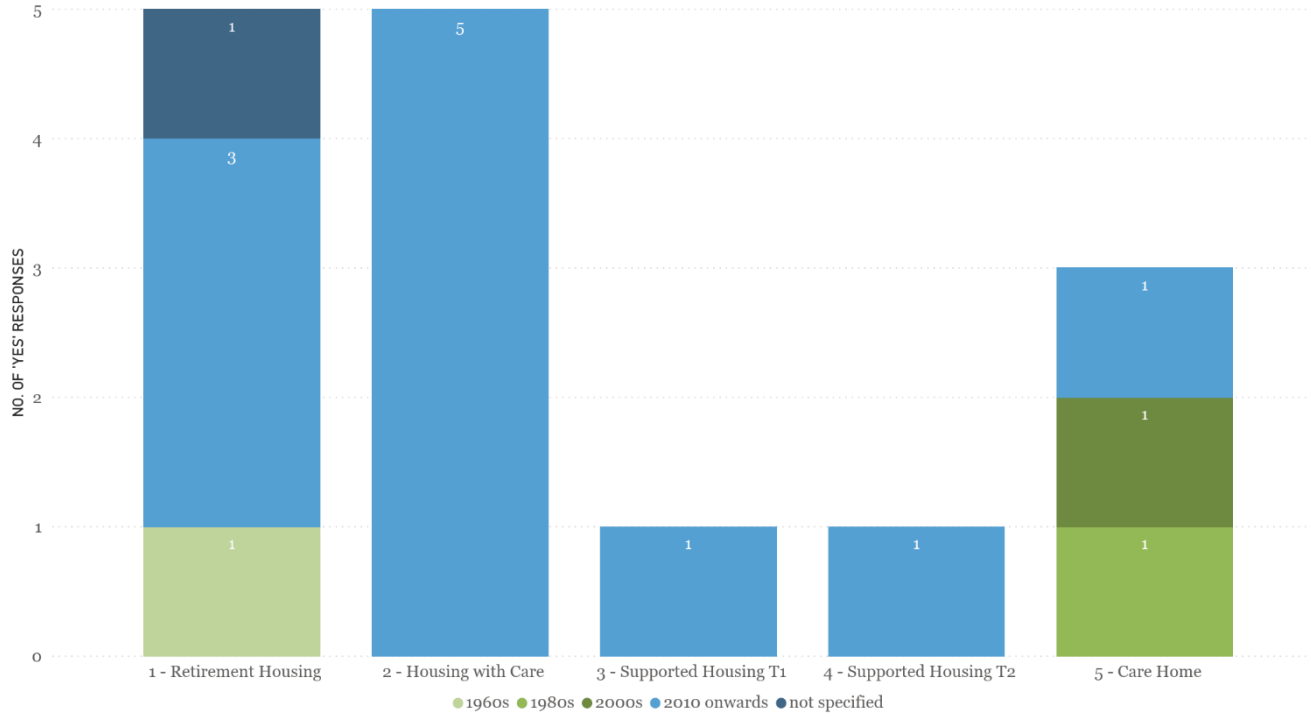
ACCOMODATION TYPES vs INDEPENDENCE

Houses and bungalows are more predominant in Retirement Housing and Housing with Care typologies - residents here are more independent and suited to living on their own. There is also a higher predominance of apartments in the Retirement Housing, Housing with Care and Supported Housing T1 types, again reflecting the level of independence of the residents.

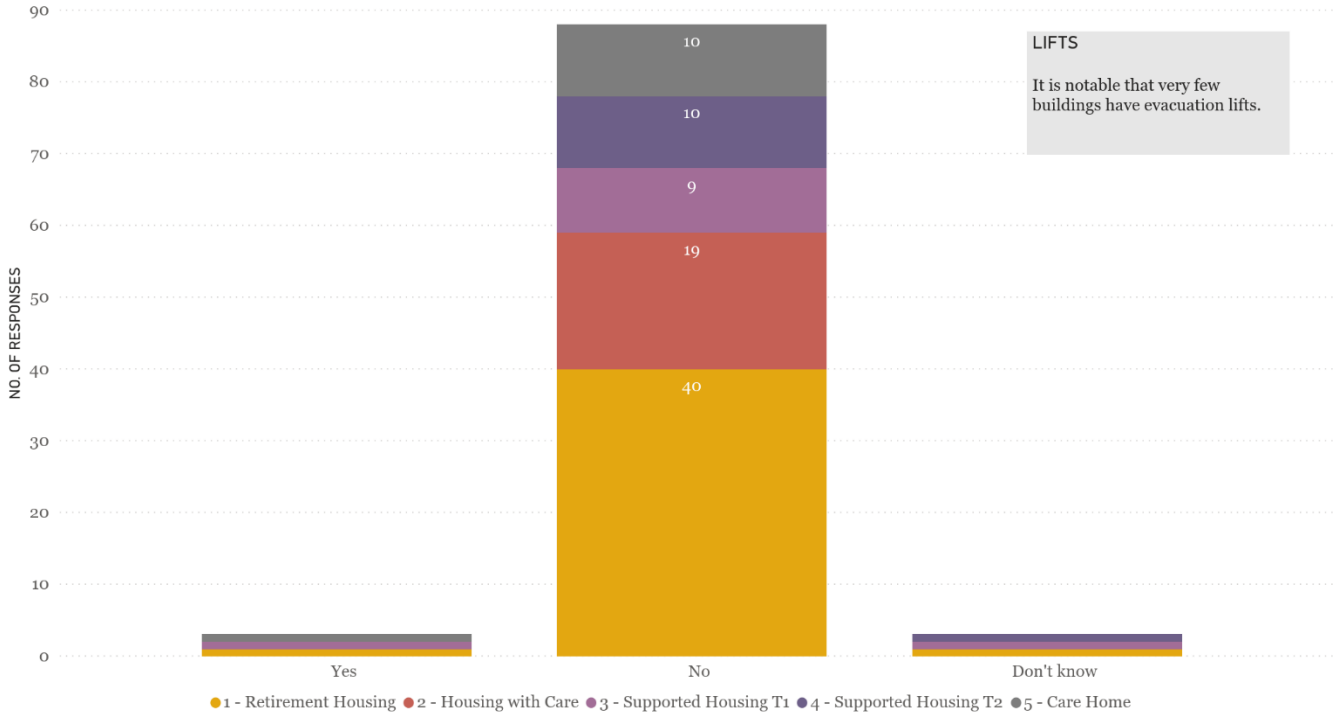
EVACUATION STRATEGIES



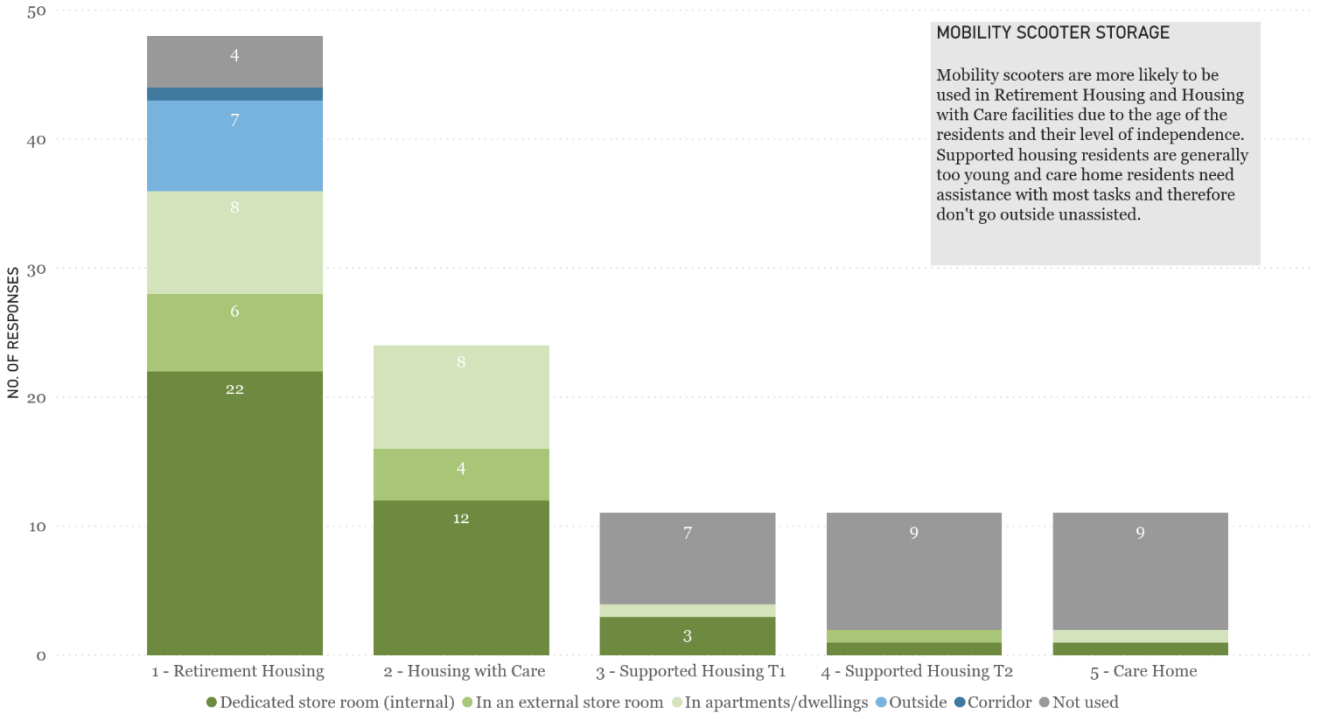
DOES THE FACILITY HAVE A SPRINKLER SYSTEM?



CAN THE LIFTS BE USED IN THE EVENT OF FIRE?



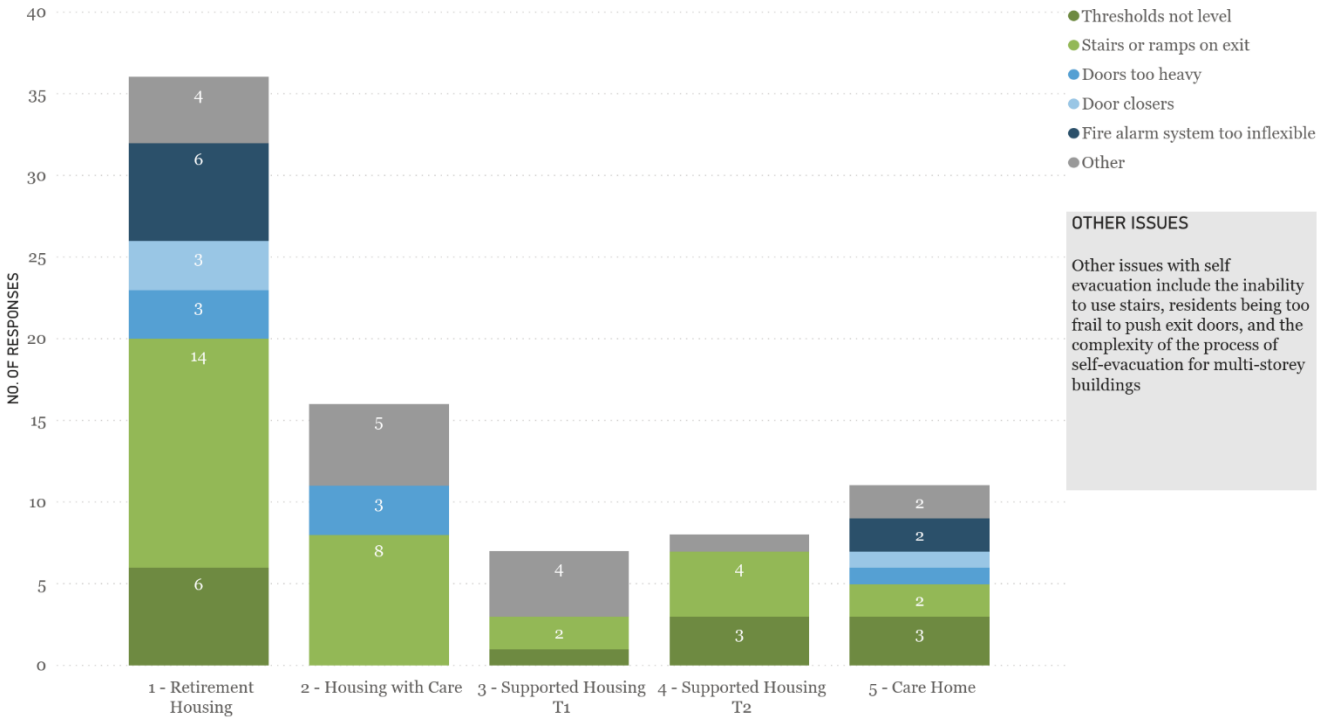
MOBILITY SCOOTER STORAGE



MOBILITY SCOOTER STORAGE

Mobility scooters are more likely to be used in Retirement Housing and Housing with Care facilities due to the age of the residents and their level of independence. Supported housing residents are generally too young and care home residents need assistance with most tasks and therefore don't go outside unassisted.

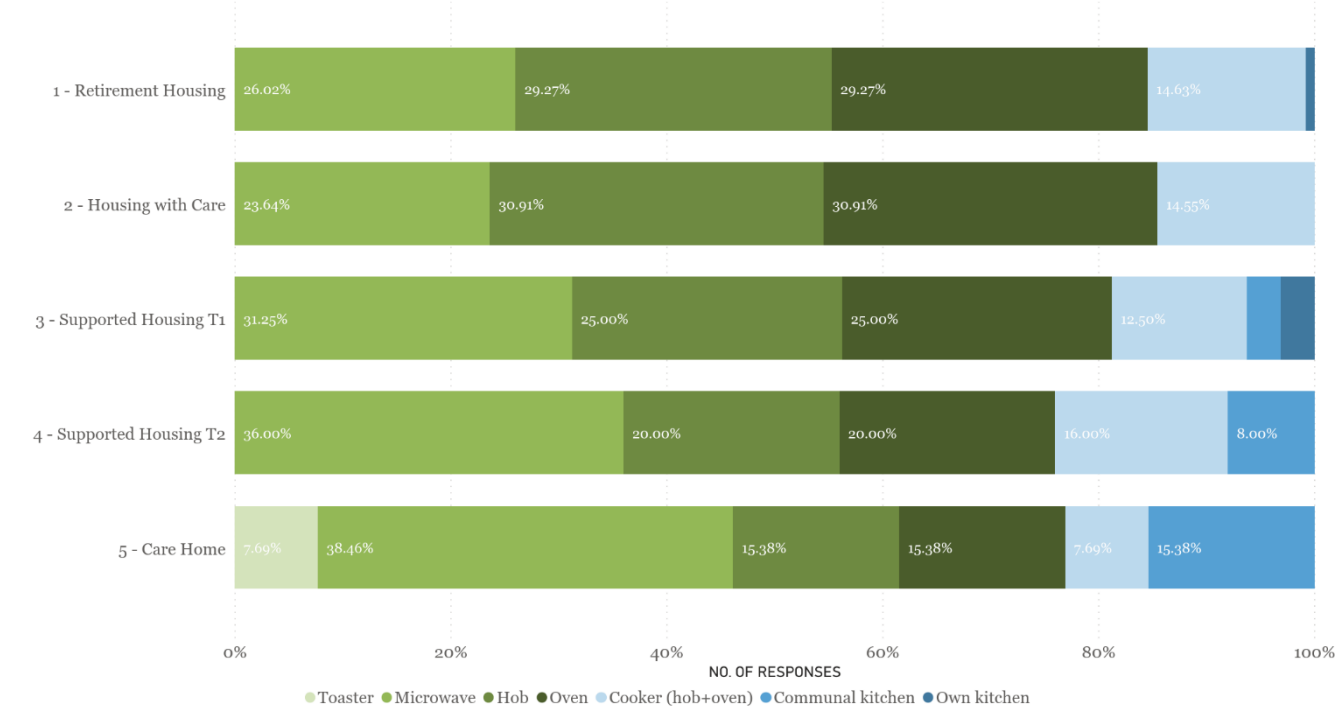
BUILDING/DESIGN ISSUES WITH SELF EVACUATION



OTHER ISSUES

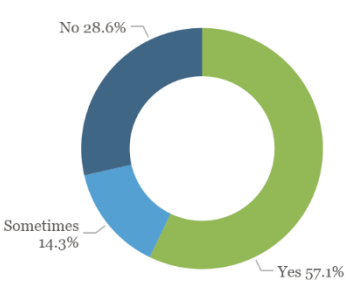
Other issues with self evacuation include the inability to use stairs, residents being too frail to push exit doors, and the complexity of the process of self-evacuation for multi-storey buildings

COOKING FACILITY PROVISION WITHIN LIVING ACCOMMODATION

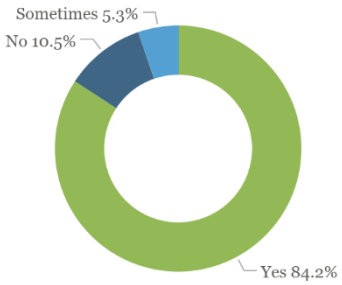


OPEN PLAN LIVING UNITS

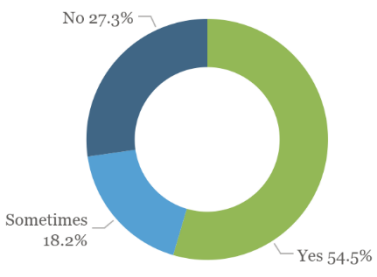
RETIREMENT HOUSES



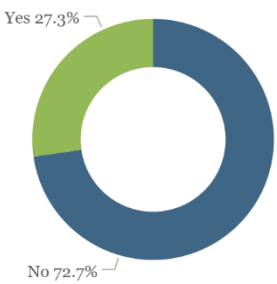
HOUSING WITH CARE



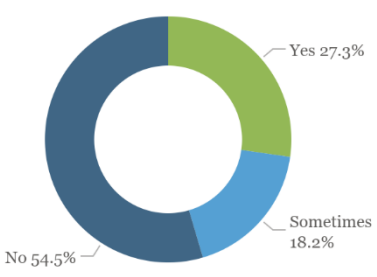
SUPPORTED HOUSING T1



SUPPORTED HOUSING

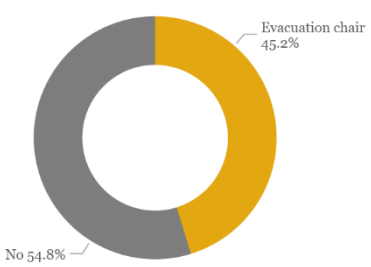


CARE HOMES

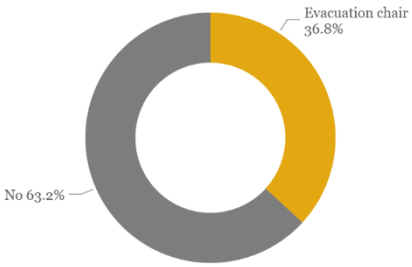


EVACUATION AIDS

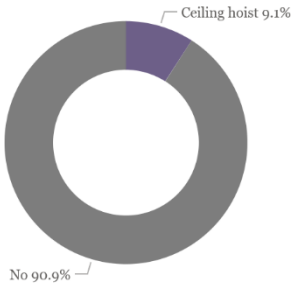
RETIREMENT HOMES



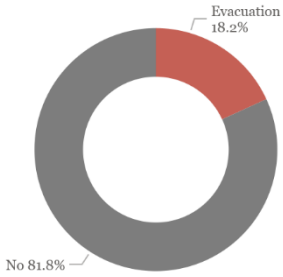
HOUSING WITH CARE



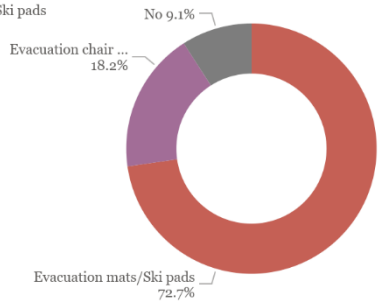
SUPPORTED HOUSING T1



SUPPORTED HOUSING T2

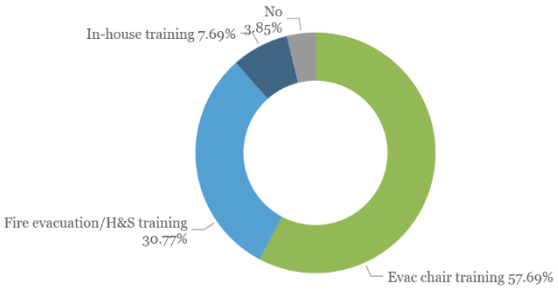


CARE HOMES

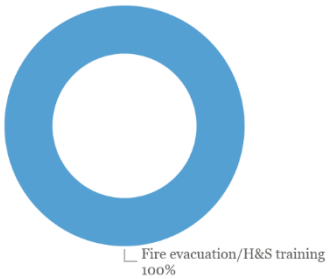


AIDS INSTALLED and the TRAINING REQUIRED to use them

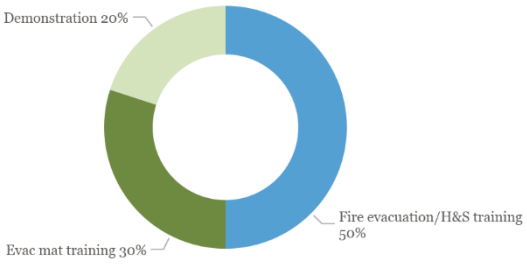
EVACUATION CHAIR



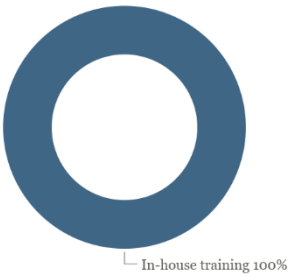
EVACUATION CHAIR plus MAT



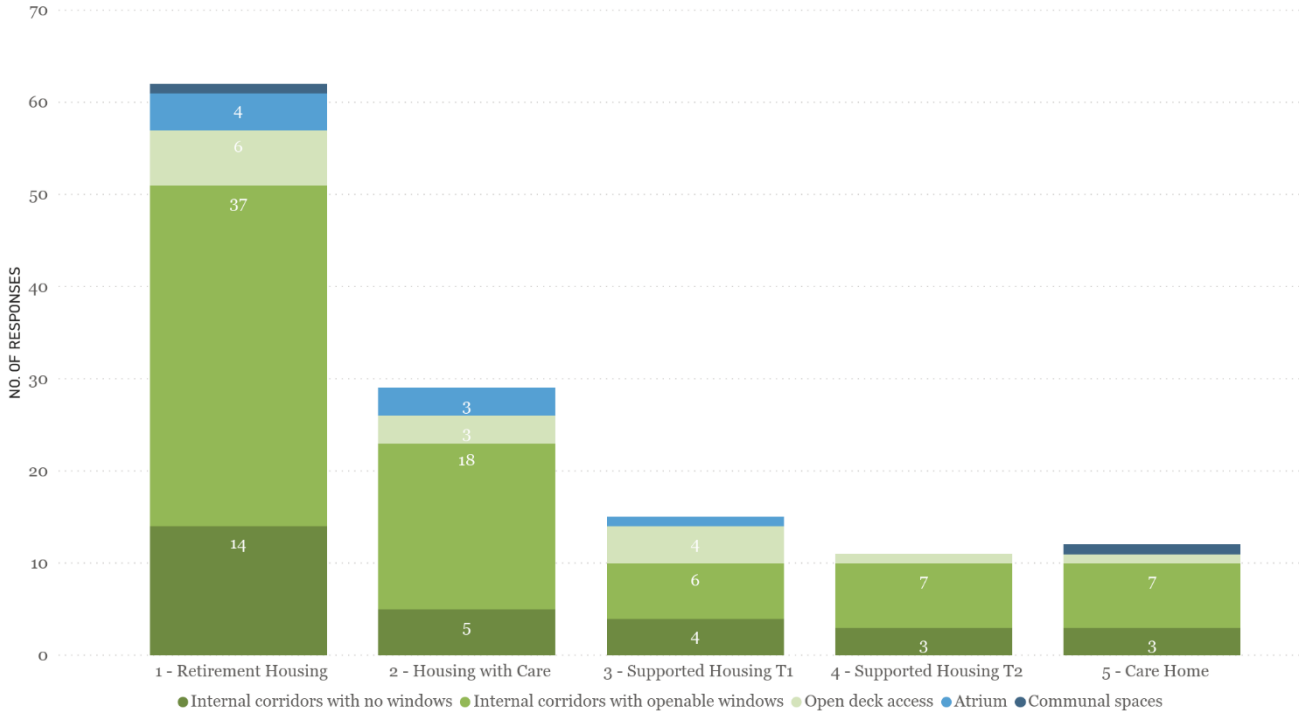
EVACUATION CHAIR/SKI PADS



CEILING HOIST

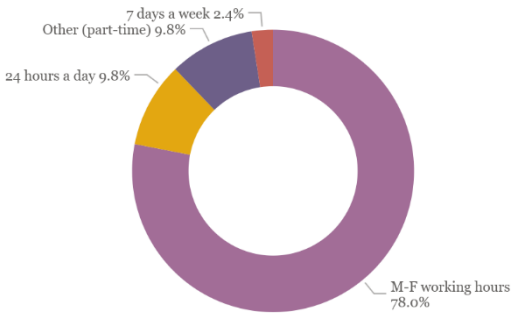


CIRCULATION SPACES

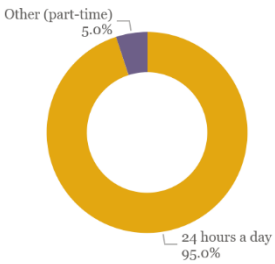


STAFFING

RETIREMENT HOUSING

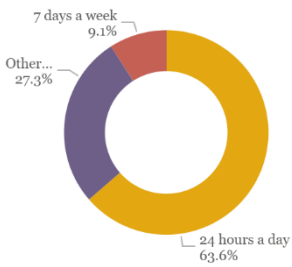


HOUSING WITH CARE



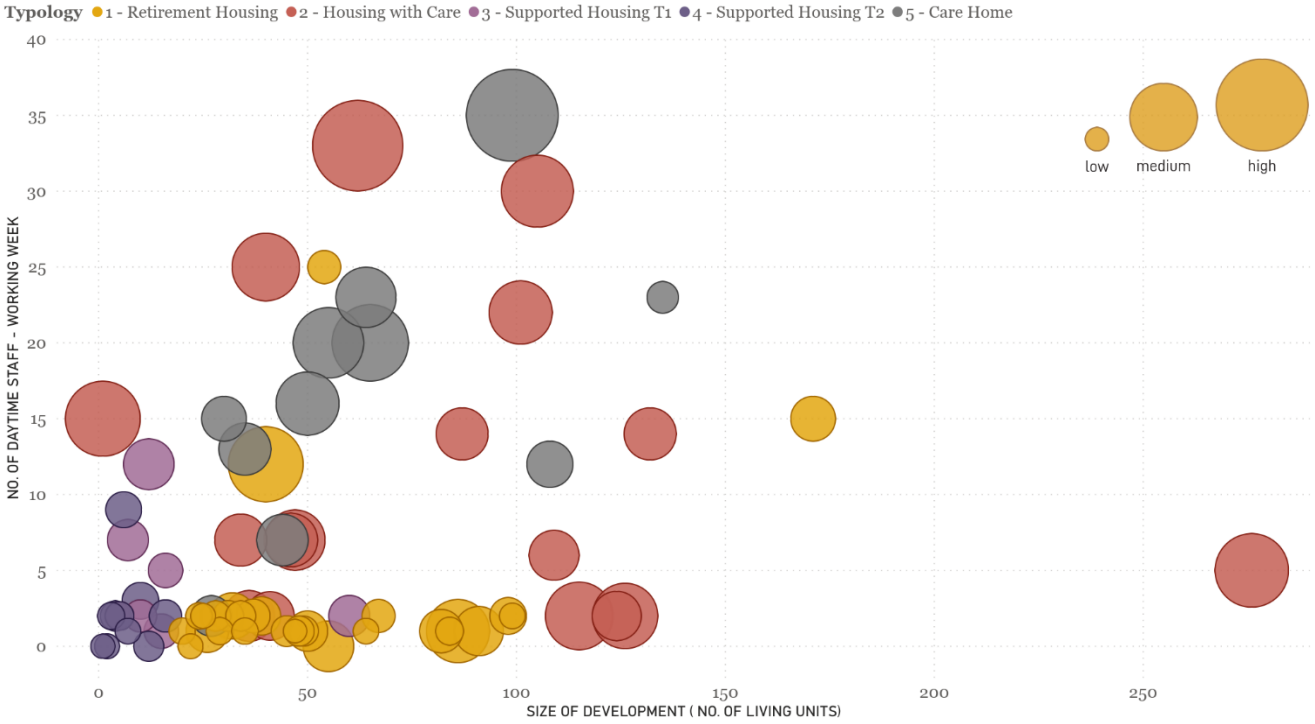
SUPPORTED HOUSING T1

SUPPORTED HOUSING T2

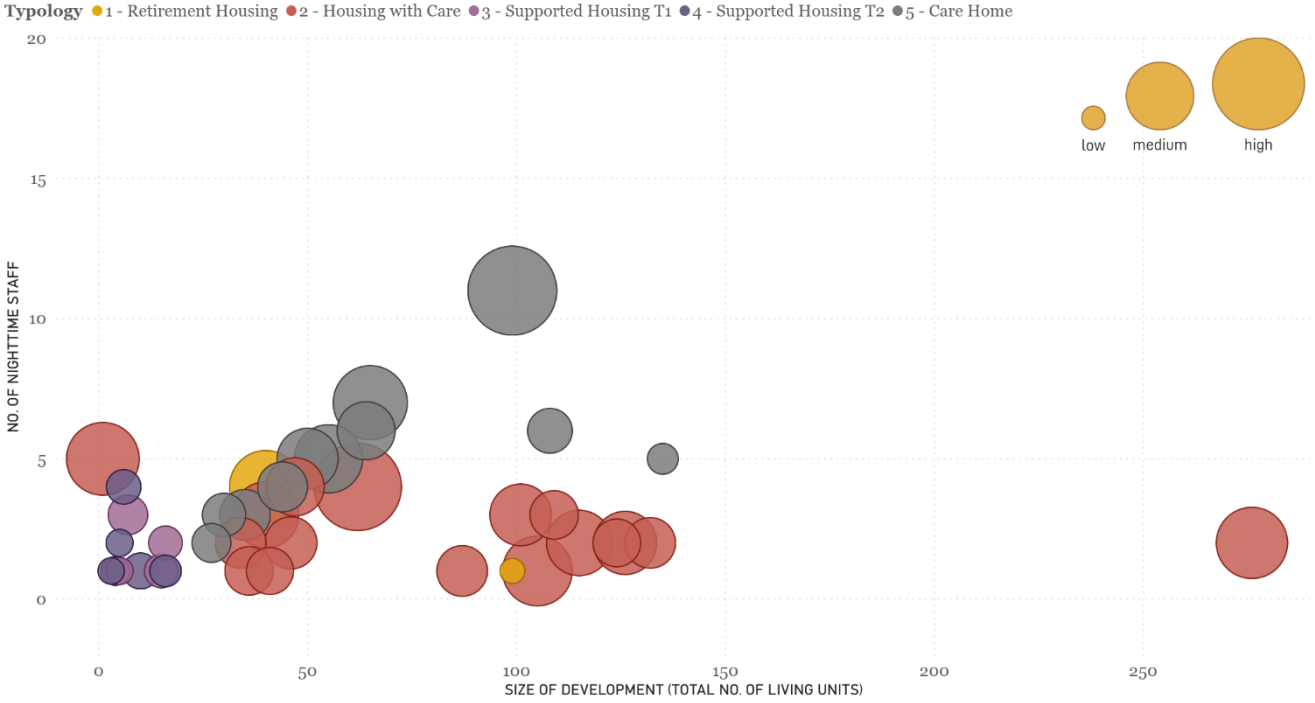


CARE HOUSING

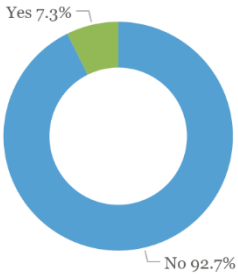
DAYTIME STAFFING LEVELS vs RESIDENT CARE NEEDS (size of circle reflects the level of care needed for the development's resident population)



NIGHTTIME STAFFING LEVELS vs RESIDENT CARE NEEDS WHERE NIGHTTIME STAFFING IS PROVIDED (size of circle reflects the level of care needed for the development's resident population)



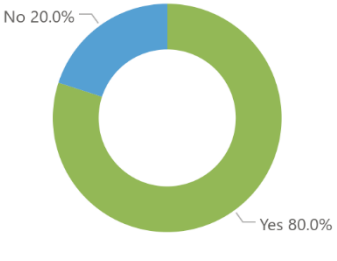
NIGHTTIME STAFFING - RETIREMENT HOUSING



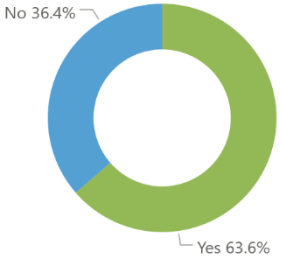
NIGHTTIME STAFFING - HOUSING WITH CARE

NIGHTTIME STAFFING - CARE HOMES

NIGHTTIME STAFFING - SUPPORTED HOUSING T1

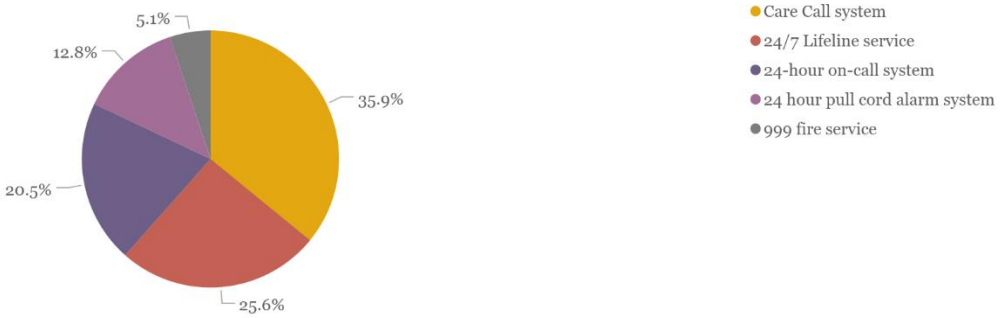


NIGHTTIME STAFFING - SUPPORTED HOUSING T2

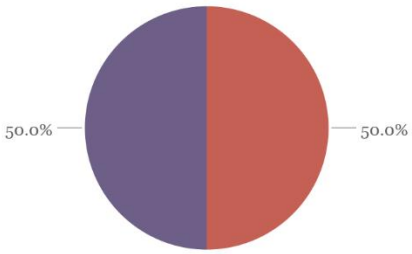


EMERGENCY NIGHTTIME PROCEDURES

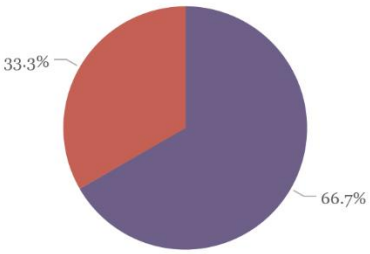
RETIREMENT HOUSING



SUPPORTED HOUSING T1

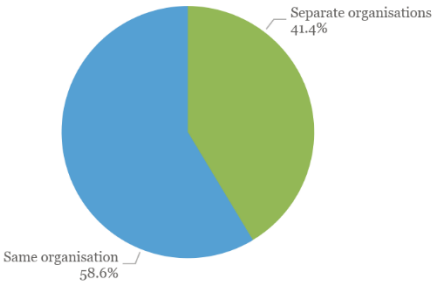


SUPPORTED HOUSING T2

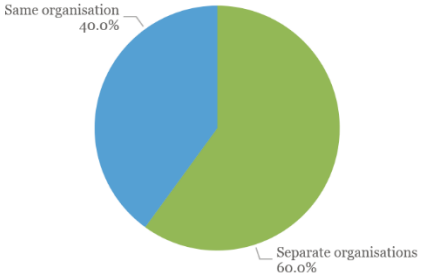


RELATIONSHIP BETWEEN MANAGEMENT AND CARE TEAM

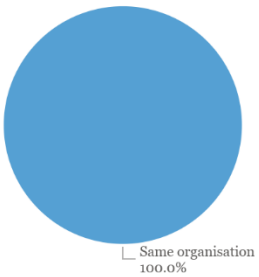
RETIREMENT HOUSING



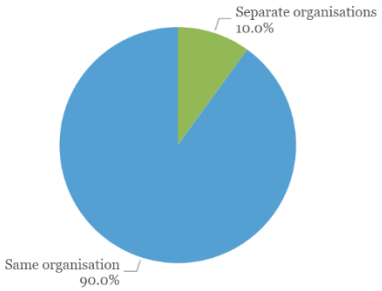
HOUSING WITH CARE



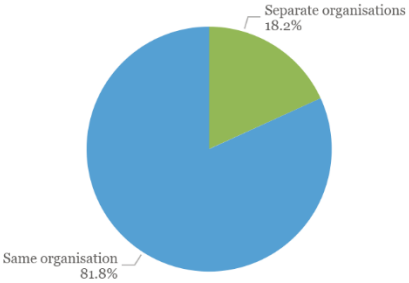
CARE HOME



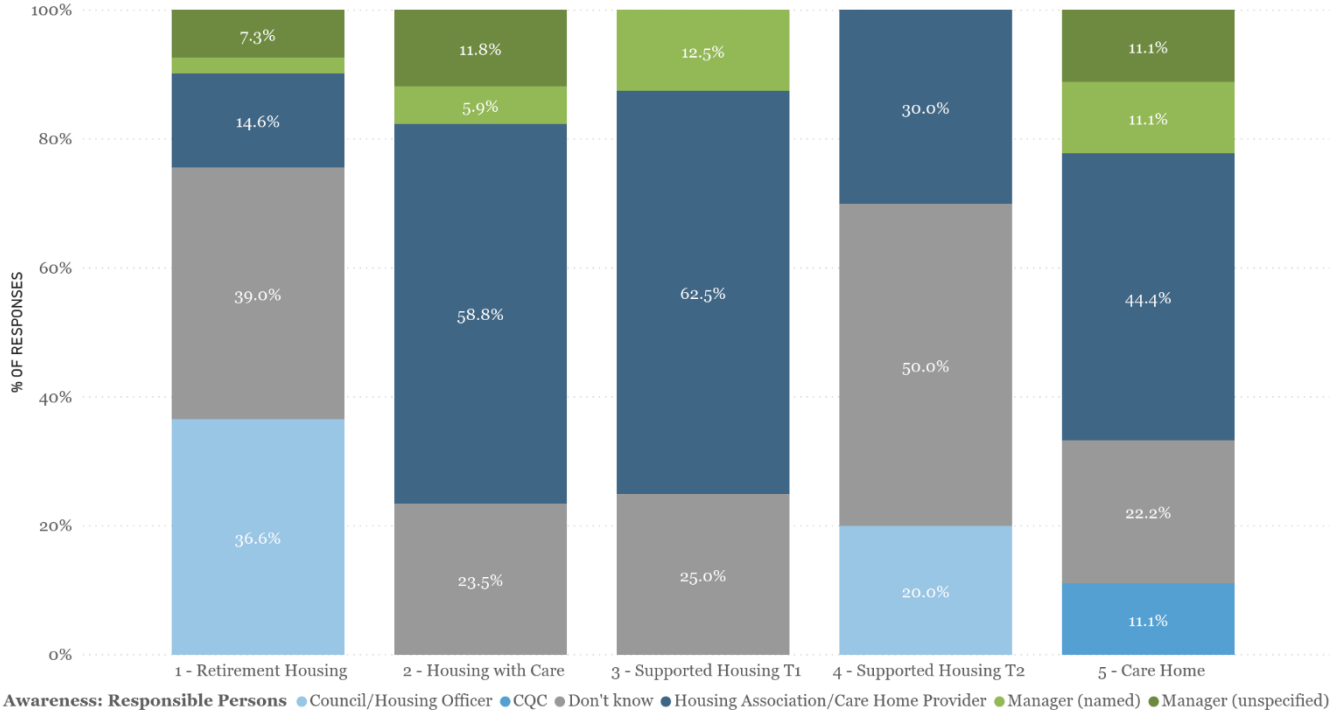
SUPPORTED HOUSING T1



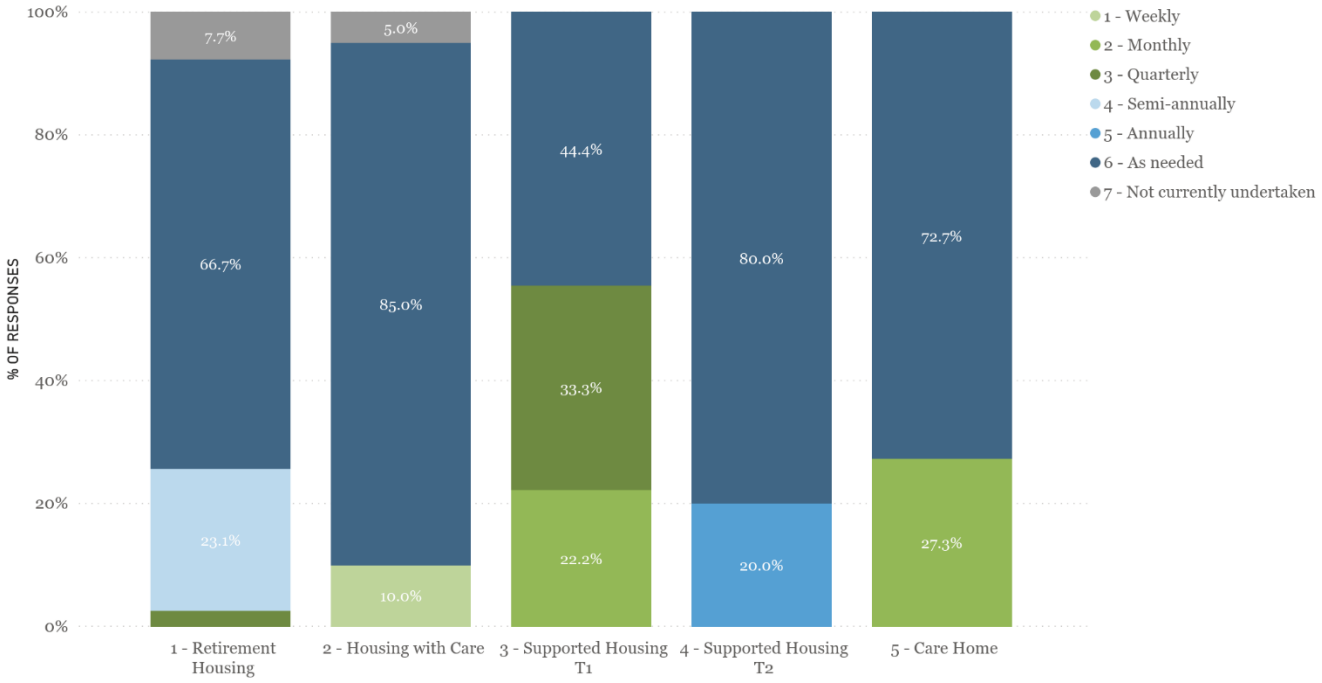
SUPPORTED HOUSING T2



RESPONSIBLE PERSON FOR THE DEVELOPMENT



HOW OFTEN ARE RISK ASSESSMENTS* CARRIED OUT?



*these risk assessments relate to a range of health and safety aspects, including fire safety provisions, and in line with the care plans for individual residents

Appendix 2 Case Studies

Case Studies across the typologies were obtained from PRP's portfolio, via other architectural practices working in the sector and from members of the Technical Steering Group. Those chosen provided a range of design responses (listed under Differentiator) which could affect the fire strategy of the building. Most of the buildings were constructed in the last 5-10 years, with the remainder constructed in the preceding 5 years.

Typology	Case Study No	Cottages/ Houses	Apartm'ts	Bedrms	No of Storeys	Location	Differentiator	Electric scooter store	Fire eng	ADB Compl.	Fire eng & ADB Compl.	Approved Doc B/ BS9991 deck access/ Fire Eng Commentary	Tenure	Developer
1. Retirement Housing	1		64		4	London	Deck Access, dual aspect apartments	No (cycle and gen store)			✓	FE (deck access issues)	Affordable	Reg. Provider
	2		29		4&5	London	Deck access and internal corridor around vert circulation	Yes			✓	FE (deck aceess with bed windows)	Affordable	Reg. Provider
	3	100	69		1,2 & 3	West Sussex	Separate residential blocks with village centre	No		✓		ADB	Private	Private
	4	2	65		3	East Sussex	Mix of deck access and corridors	Yes			✓	FE (atrium voids)	Affordable	Local Authority
	5		170		5& 7	London	Separate cores joined at ground floor	Yes			✓	FE (extend travel mech smoke ext)	Mixed	Developer - Reg. Provider
	6		31		2	Leicestershire	Winter Gardens and deck access	Yes		✓		ADB and BS9991	Affordable	Charity
2. Housing with Care	7		52		4	London	Mix of deck access and corridors	Yes		✓		ADB	Affordable	Reg. Provider
	8		51		3&4	London	Internal atrium, dementia specific	Yes			✓	FE (Atrium voids, extended travel and hose lengths)	Affordable	Local Authority
	9		102		5	Warwickshire	double and single banked corridors, double height entrance	Yes			✓	FE (Entrance atrium floor void, mech smoke extract due to non opening corridor windows aesthetics, extended sky lounge escape distances)	Mixed	Reg. Provider
	10		105		3,4&5	West Sussex	Individual cores linked at ground floor, timber cladding	Yes			✓	FE (extended travel mech smoke extract)	Mixed	Developer - Reg. Provider
	11		60		4&1	London	Deck Access, connected to an existing building	Yes			✓	FE (deck access not enough free vent re BS9991)	Affordable	Reg. Provider
	12	7	94		2&3	Kent	Separate residential blocks, village centre in refurbished building	Yes	✓	✓	✓	Historic house FE (atrium smoke extract). Historic stables ADB. New blocks ADB.	Private	Private
	13		65		9	London	Tall building, recladding (ACM) although purpose built extra care	Yes			✓	FE with mech smoke extract to windowless corridor.	Affordable	Reg. Provider
	14		75		2&3	Staffordshire	Connected to a converted barn building, high level links	Yes		✓		ADB	Affordable	Reg. Provider
3. Supported Housing Type 1	15		19		4	London	Mental health apartments but CQC registered as a care home	No (cycle store only)		✓		ADB	Affordable	Reg. Provider
	16		8		3	London	Learning Disabilities	No (garden store only)		✓		ADB	Affordable	Local Authority
	17		12		2&3	Kent	Learning Disabilities	No		✓		ADB	Affordable	Local Authority
	18		7		2&4	London	Learning Disabilities	No		✓		ADB	Affordable	Local Authority
	19		9		2	London	Learning Disabilities	No		✓		ADB likley	Affordable	Local Authority
	20		24		1&2	London	Learning Disabilities	No			✓	Suspect FE (too many flats open direct to single escape stair ADB max is 2)	Affordable	Reg. Provider
4. Supported Housing Type 2	21			8	3	London	Learning Disabilities	No	✓			FE only has one stair and no sub compartments.	Affordable	Local Authority
	22			6	1&2	London	Learning Disabilities	No		✓		ADB	Affordable	Local Authority
	23			10	2	London	Mental Health	No		✓		ADB	Affordable	Reg. Provider
	24			8 (4 per flat)	2(3)	London	Dementia, timber frame, connected to extra care scheme	No		✓		ADB	Affordable	Reg. Provider
5. Care Home	25			70	3	Surrey	care home with apartments as part of the registered care home	No (wheelchair store only)			✓	FE (extended travel distances)	Private	Private
	26			87	3	Surrey	care home including dementia care	No	✓			FE	Private	Private
	27			98	6	London	18.750 meters / 6 storeys/ fire engineered/ substation inside building	cycle/scooter st	✓			FE	Private	Private
	28			55	3	Sussex	Lower ground floor part buried	No		✓		ADB	Private	Charity
	29			66	3	Wiltshire	Straightforward care home	No		✓		ADB	Affordable	Reg. Provider
	30			60	2	Surrey	Care home with double height spaces	No (wheelchair store only)		✓		ADB	Private	Private
	31			30	2&3	Surrey	Care home with care hub for wider village on ground floor	Yes	✓			FE as beds open onto communal spaces including 'kitchen'	Affordable	Charity
6. Mixed Typologies	32			104	3	Kent	Sheltered housing, recuperative care, day centre & LD supported housing	Yes		✓		ADB	Affordable	Local Authority
	33			81	4	Greater Manchester	Extra Care Housing, GP Surgeries, nursery, library and community café	Yes		✓		ADB	Affordable	Reg. Provider
	34			94	3	London	Includes extra care, dementia unit, LD unit	No			✓	FE (extended fixed dry riser pipe horizontal lengths)	Affordable	Local Authority

Outline Case Studies Detailed Case Studies

Appendix 3 Summary of Collected Publications and Research

Reference Documents

1. A. Rahouti, R. L. (2020). *Human behaviour during a healthcare facility evacuation drills: Investigation of pre-evacuation and travel phases .* Elsevier Ltd.
2. AHRM. (2020). *Mobility Scooters.* Retrieved from AHRM: www.ahrm.com
3. ARCO. (2020). *Fire Safety Commitment .* London.
4. ARUP, & University, Y. (2020). EMERGENCY EGRESS FOR THE ELDERLY IN CARE HOME FIRE SITUATIONS. *Fire and Materials (a John Wiley Journal)*, 44.
5. ArupFire. (2010). *Sprinklers for Safer Living.* Sheffield: Sheffield.
6. BRE Global Client Report . (2016). *Fire Experiments on Mobility Scooters Protected by Sprinklers .* London: BRE Global Ltd. .
7. BRE Trust Project. (2015). *Heat Release and Smoke Production from burning Mobility Scooters .* BRE Global Ltd.
8. (1990). *BS 5588-1:1990_Fire Precautions in the design, construction, and use of buildings - Part I Code of Practice for Residential Buildings.* BSI.
9. (2015). *BS 9991:2015_Fire Safety in the design, management and use of residential buildings - Code of Practice.* BSI.
10. CFOA. (2018). *Ageing Safely .* Tamworth: CFOA Publications Ltd.
11. Crowder, D., & Charters, D. (2013). *Evacuating Vulnerable People and Dependent People from Buidlings in an Emergency.* Watford: BRE Trust; IHS.
12. CS Development Team. (2015). *Assisted Living Technology Catalogue.* London Fire and Emergency Planning Authority.
13. Cull, T. (2006). *Sprinkler Effectiveness in Care Homes .* London: ODPM.
14. Dutch Burns Foundation; Information Centre for Safety (Infopunt Veiligheid); Fire prevention research department of the Institute for Safety . (2016). *Fire safety and the ageing population .* Arnhem: Infopunt Veiligheid).
15. Friesinger, J. G., Topor, A., Bøe, T. D., & Larsen, I. B. (2019). *The ambiguous influences of fire safety on people with mental health problems in supported housing.* PALGRAVE COMMUNICATIONS.
16. Group, L. E., & LFB. (2020). *Fire Engineering Thematic Technical Report Quarter 1&2.* London: LFB.
17. HARPUR, A. P., BOYCE, K. E., & MCCONNELL, N. (2014). *An Investigation into the Circumstances Surrounding Elderly Dwelling Fire Fatalities and the Barriers to Implementing Fire Safety Strategies among this Group .* Newtownabbey, Northern Ireland, UK: INTERNATIONAL ASSOCIATION FOR FIRE SAFETY SCIENCE/.
18. Harrison, R., Campbell, D. S., Fraser-Mitchell, D. J., & Williams, D. C. (2004). *Effectiveness of sprinklers in residential premises, Section 3: Pilot Study.* Building Research Establishment .
19. Housing LIN. (2010). *Fire Safety in Extra Care Housing in the UK.* London.
20. Housing LIN. (2016). *Fire Safety in Specialised Housing .* London.
21. Housing LIN. (2020). *Design and cost considerations in extra care housing .* London.
22. Housing LIN. (2020). *Design Principles for extra care housing - Factsheet no.6.* London.
23. Innovation Fire Engineering . (2020). *Care Home and Specialised Housing Research.* London.
24. IRS. (2012). *IRS Help and Guidance .* UK: Communities and Local Government.
25. Kelly, D. F., & Heward, D. M. (2015). *Fire Safety Innovations for People Affected by Dementia.* Dorset: Bournemouth University Dementia Institute .
26. LFB. (2019). *Home Fire Safety Risk Referral Matrix.* London.
27. LFB. (2020). *Care Home Fires and Specialised Housing Fires redacted, 2014 - 2019.* London.
28. LFB. (2020). *Compartmentation Issues, For periods Quarter 3 2018/19.* London.
29. MHCLG . (2018). *English housing Survey, Fire and Safety 2016-17.* London.
30. MHCLG. (2020). *Home Office Statistical Bulletin 22/20.* London.
31. MHCLG. (2020). *Technical Review of Approved Document B .* Building Regulation.
32. NFCC. (2018). *Mobility Scooter Guidance for Residential Buildings .* UK.
33. NFCC. (n.d.). *Fire Safety in Specialised Housing .* London.
34. NFCC; NFSN. (2019). *Efficiency and Effectiveness of Sprinkler Systems in the UK: An Analysis from Fire Service Data.* NFCC.
35. Pichler, J., Tannahill, R., & Gales, J. (2015). *ARCHITECTURAL CONSIDERATIONS FOR EGRESS IN NURSING AND LONG TERM CARE HOMES.* York: York University.

36. Proulx, P. G. (2002). *Evacuation planning for occupants with disability.* Ottowa: National Research Council of Canada. Institute for Research in Construction.
37. Runefors, M. (2020). *Fatal Residential Fires: Prevention and Response.* Lund: Lund University.
38. Runefors, M., Johansson, N., & van Hees, P. (2017). *The effectiveness of specific fire prevention measures for different population groups .* Lund: Lund University .
39. Sørensen, J. G. (2014). *Evacuation of People with Visual Impairments.* DTU: Technical University of Denmark
40. Approved Document B (fire safety) volume 1: Dwellings, 2019 edition incorporating 2020 amendments

Guidance Documents (selected from referenced documents)

31. MHCLG. (2020). *Technical Review of Approved Document B .* Building Regulation.
- Overview of the research programme to inform policy options for changes to the Approved Document B. Focuses on the Short to Long term workstreams for the ADB review.

8. (1990). *BS 5588-1:1990_Fire Precautions in the design, construction, and use of buildings - Part I Code of Practice for Residential Buildings.* BSI.

9. (2015). *BS 9991:2015_Fire Safety in the design, management and use of residential buildings - Code of Practice.* BSI.

40. Approved Document B (fire safety) volume 1: Dwellings, 2019 edition incorporating 2020 amendments

Referenced Documents Summary

A. Rahouti, R. L. (2020). *Human behaviour during a healthcare facility evacuation drills: Investigation of pre-evacuation and travel phases .* Elsevier Ltd.
- This paper describes new evacuation datasets for healthcare facility evacuation simulation. Data was collected from an outpatients' area of a public hospital in New Zealand.

AHRM. 2020. "Mobility Scooters." AHRM. www.ahrm.com.
- Describes ARHM's good practices in fire safety regarding mobility scooters. Refers to legislation and guidance and from those creates its own fire safety considerations.

ARCO. (2020). *Fire Safety Commitment .* London.
- This document expresses company considerations for strategic risk management. Focusses on person-centred risk approaches.

ARUP, and York University. 2020. "EMERGENCY EGRESS FOR THE ELDERLY IN CARE HOME FIRE SITUATIONS." Fire and Materials (a John Wiley Journal) 44.
- A journal article addressing the specific data and knowledge gap of emergency egress of the elderly through human behaviour and egress modelling. The study demonstrated travel speed and pre-movement is subject to limitation with qualitative behavioural insights of residents.

ArupFire. (2010). *Sprinklers for Safer Living.* Sheffield: Sheffield.
- This study aims to identify the key life safety, property protection and business continuity risks associated with fires in these types of premises and residences and, by reviewing international guidance documents and current research on fire safety and human behaviour, consider ways that these risks can be reduced to an acceptable level.

BRE Global Client Report .2016. Fire Experiments on Mobility Scooters Protected by Sprinklers London: BRE Global Ltd.
- BRE Global reports on the findings of 2 experiments pf mobility scooter ignition and the diverse fire behaviours of scooters that can be mitigated by sprinkler systems. The results provide data resources for fire safety engineering of flats, care homes and other sheltered accommodation mobility scooters may be expected to be found in.

BRE Trust Project. 2015. Heat Release and Smoke Production from burning Mobility Scooters. BRE Global Ltd.

- This report by BRE Trust describes experiments to quantify the typical production of quantities of smoke and heat from a burning mobility scooter. The experiment's data is intended to aid fire engineers, designers, fire risk assessors and enforcers working in the care home sector. It hopes to also inform decision-makers in properties that use mobility scooters.

CFOA. (2018). *Ageing Safely .* Tamworth: CFOA Publications Ltd.

- This document is independent advice to the government on fire prevention, protection, intervention and a wide range of community safety and rescue matters. Mainly focuses on adult and community services.

Crowder, David, and David Charters. 2013. Evacuating Vulnerable People and Dependent People from Buildings in an Emergency. Watford: BRE Trust; IHS.

- This guide describes different evacuation strategies for various decision-makers such as fire safety managers/engineers, nursing staff, and approval authorities. Among strategy considerations, it gives an overview of various fire safety management systems for various settings such as passive, suppression and detection fire and alarm systems.

CS Development Team. (2015). *Assisted Living Technology Catalogue.* London Fire and Emergency Planning Authority.

- This is a reference guide that provides a recommended list of various assistive technologies that can support the independence, wellbeing, and safety of individuals. The options they list is specifically to assist in preventing, detecting and escaping fires.

Cull, T. (2006). *Sprinkler Effectiveness in Care Homes .* London: ODPM.

- The overall aim of the project has been to gather information on the nature of fire injuries and fatalities in care homes in the context of the life-safety benefits of sprinklers fitted in the room of fire origin. This information will be used to further inform the AD B consultation and revision process.

Dutch Burns Foundation; Information Centre for Safety (Infopunt Veiligheid); Fire prevention research department of the Institute for Safety . (2016). *Fire safety and the ageing population .* Arnhem: Infopunt Veiligheid).

- This report observes elderly (over-65s) in similar housing types which involved fatalities, wounded people or at lease undesirable evacuation.

Friesinger, J. G., Topor, A., Bøe, T. D., & Larsen, I. B. (2019). *The ambiguous influences of fire safety on people with mental health problems in supported housing.* PALGRAVE COMMUNICATIONS.

- This report emphasize the need for appropriate and well-considered fire safety as a public health intervention in supported housing.

Group, London Engineering, and LFB. 2020. Fire Engineering Thematic Technical Report Quarter 1&2. London: LFB.

- This report relates to data collection of the design phase and the occupation phase of the buildings in question. The data is meant to be for informational purposes to stakeholders in building design and fire safety regarding poor building design, management/maintenance which can increase the risk to residents, communities and emergency responders.

HARPUR, A. P., BOYCE, K. E., & MCCONNELL, N. (2014). *An Investigation into the Circumstances Surrounding Elderly Dwelling Fire Fatalities and the Barriers to Implementing Fire Safety Strategies among this Group .* Newtownabbey, Northern

- Analysis of circumstances around elderly dwelling fire fatalities gleaned from coronial reports, which identified were mainly involved in ignition and had existing health conditions that played a role in the fire.

Harrison, R., Campbell, D. S., Fraser-Mitchell, D. J., & Williams, D. C. (2004). *Effectiveness of sprinklers in residential premises, Section 3: Pilot Study.* Building Research Establishment .

- This is a Pilot Study that reviews statistical and other information on effectiveness of sprinklers in reducing life loss and property damage. International information will also be referenced and may not be directly applicable to UK situations.

Housing LIN. (2010). *Fire Safety in Extra Care Housing in the UK.* London.
- Technical brief that looks at fire avoidance and control strategies in Extra Care Housing developments implemented at design and construction stages with particular reference to lessons learnt and current day legislation.

Housing LIN. (2016). *Fire Safety in Specialised Housing .* London.
- This is a briefing note that updates fire safety design and operational guidance and recommendations associated wit Extra Care Housing. Refers to current legislation and guidance.

Housing LIN. (2020) Design principles for extra care housing –Factsheet No6.
- This refreshed factsheet considers the progress made in designing extra care housing to the HAPPI design quality principles and latest accessibility requirements for an ageing population, including reference to fire protection and means of escape.

Housing LIN. (2020) *Design and cost considerations in extra care housing*
- This report and cost modelling tool has been updated to take into account lessons from the COVID-19 pandemic, fire safety and fire protection following Grenfell, and residents of extra care housing's wider health and social care determinants

Innovation Fire Engineering . (2020). *Care Home and Specialised Housing Research.* London.
- IFE created a report for this research methodology specifically comparing guidance documents to current ADB standards. It aims to ensure that ADB provides adequate guidance for building types in scope to meet minimum requirements.

IRS. 2012. IRS Help and Guidance. UK: Communities and Local Government.
- This is a How-To guidance on using the Incident Recording System which was created for the Fire and Rescue Service.

Kelly, D. F., & Heward, D. M. (2015). *Fire Safety Innovations for People Affected by Dementia.* Dorset: Bournemouth University Dementia Institute
- This project report aims to develop guidance to help people affected by memory problems or dementia to be safer in their homes, enhance their quality of life, and train fire and rescue personnel how to work with such people in an emergency situation. For national and international use.

LFB. (2019). *Home Fire Safety Risk Referral Matrix.* London.
- Matrix outlining fire, welfare risk standards from High Risk A to Low Risk B descriptions. Guidance notes also stated.

LFB. 2020. "Care Home Fires and Specialised Housing Fires redacted, 2014 - 2019." London.
- This is a collection of data from recorded fire incidents regarding fire's ignition source, severity of injuries, number of rescues and victim conditions, compartmentation of fires, number of evacuations, spread of fires and victim roles within Care Homes and Specialised housing between 2014-2020.

LFB. 2020. "Compartmentation Issues, For periods Quarter 3 2018/19." London.
- This thematic report looks at fire safety data specifically regarding compartmentation obtained from SFSO reports received by Fire Investigation Team (FIT). Among compartmentation, it describes key issues for escape route and management within the reports FIT received.

MHCLG . 2018. "English housing Survey, Fire and Safety 2016-17." London.
- This national survey reports on people's housing circumstances and the condition and energy efficiency of housing in England. This specific report examines the incidence and prevalence of fires at home and the current safety measures households have in place and the prevalence of serious fire hazards in the home.

MHCLG. 2020. "Home Office Statistical Bulletin 22/20." London.
- Statistics and incidents attended by fire and rescue services (FRSs) in England for the year ending March 2020. Sourced from the Home Office's online IRS.

NFCC. 2018. "Mobility Scooter Guidance for Residential Buildings." UK.

- This guide is meant to provide considerations for responsible personnel of residential buildings to help establish the safe use, storage and charging of mobility scooters. It gives various examples of circumstances where scooters may be a risk and assess current circumstances that may create such risks. It refers as well to current legislation and guidance.

NFCC. (n.d.). *Fire Safety in Specialised Housing .* London.

- This guide is to help ensure adequate fire safety in existing specialised housing and is concerned with fire safety in specialised housing for multiple residents. Provides practical advice on assessing risk from fire for appropriate responsible parties.

NFCC; NFSN. (2019). *Efficiency and Effectiveness of Sprinkler Systems in the UK: An Analysis from Fire Service Data.* NFCC.

- This analysis compiles different studies data and results confirming the general benefits of sprinkler installation. Focusses on dwelling fires.

Pichler, J., Tannahill, R., & Gales, J. (2015). ARCHITECTURAL CONSIDERATIONS FOR EGRESS IN NURSING AND LONG TERM CARE HOMES. York: York University.

- This paper outlines the challenges presented when egressing nursing and LTC homes, and how they could be improved by considering proper architectural design.

Proulx, P. G. (2002). *Evacuation planning for occupants with disability.* Ottowa: National Research Council of Canada. Institute for Research in Construction.

- This paper reviews the different strategies presented in the literature and discusses various approaches being considered in Canada.

Runefors, M. (2020). *Fatal Residential Fires: Prevention and Response.* Lund: Lund University.

- This report exposes results that indicate effectiveness of smoke alarms and detector-activated sprinklers. This report also analyses data regarding fire service response, and other emergency services.

Runefors, M., Johansson, N., & van Hees, P. (2017). *The effectiveness of specific fire prevention measures for different population groups .* Lund: Lund University .

- The effectiveness of the different studied measured in this report are presented in terms of fraction of fatalities averted and the benefit per implemented measure. The results presented in this paper is novel and can be used to motivate targeted interventions and for cost-benefit analyses.

Sørensen, J. G. (2014). *Evacuation of People with Visual Impairments.* DTU: Technical University of Denmark.

- This qualitative and quantitative report observes made during the experiments showed that participant generally behaved altruistically and assisted fellow participants to evacuate. There are examples of elderly people guiding and assisting children to evacuate, deaf people assisting mobility impaired people, and able-bodied individuals who lend a helping hand to a blind participant and guide him to

Appendix 4 Guidance Document Comparison

Sl. No	Guidance Document	Scope	Fire Detection	Fire Suppression	Means of Escape	Fire Resistance and external fire spread	Notes (if any)
1	ADB	Residential Care Homes	Category L1 as per BS 5839-1	Sprinklers not mandatory. If sprinklers are provided: (i) fire doors to bedrooms not to be fitted with self-closing devices; (ii) protected area can have > 10 beds; (iii) bedrooms may contain more than 1 bed	Evacuation Strategy recommended - Progressive Horizontal Evacuation (PHE) or Simultaneous Evacuation PHE - each storey requires at least 3 protected areas Every protected area to be provided with at least 2 exits to adjoining, but separate protected areas Travel distance - 9 m (one direction only), 18 m (more than one direction). The maximum travel distance from any point should not be more than 64 m to a storey exit or a final exit Escape routes should not pass through ancillary accommodation	**Table B4 Continued** Purpose group of building / Minimum periods of fire resistance† (minutes) in a: Basement storey* including floor over; Ground or upper storey; Depth (m) of the lowest basement; Height (m) of top floor above ground, in a building or separated part of a building More than 10 / Up to 10 / Up to 5 / Up to 11 / Up to 18 / Up to 30 / More than 30 2 Residential a Institutional: 90 min / 60 min / 30 min / 60 min / 60 min / 90 min / 120 min Each bedroom in a care home should be enclosed in fire resisting construction (minimum REI 30) with fire resisting doors (minimum E 30). For buildings with a storey height at least 18 m above ground level, all materials which become part of an external wall or specified attachment achieve class A2-s1, d0 or class A1, other than those exempted by regulation 7(3).	
2	BS 9991:2015	Specialised housing Note: Residential care home is outside the scope of BS 9991	Automatic transmission should be provided if occupants are mobility impaired to a degree that would cause them to be at high risk in the event of fire, or if there is any reason to suspect that occupants would be unlikely or unable to alert the fire and resuce service. Where warning devices are installed in specialised housing, they should cater for the applicable sensory conditions and therefore should be combatible with specialist devices such as vibrating alerters, visual alarm systems etc. Warning devices should also allow for supplementation where PEEPs dictate a particular need.	In flats where occupants are not capable of independent evacuation automatic water fire suppression system (AWFSS) is recommended.	**1. Travel Distance** Where assistance is required for evacuation, no person would have to travel more than 7.5 m from the flat entrance door along a corridor or lobby before reaching a fire door accessing either a protected stairway enclosure or another protected corridor zone. Internal travel distance within accommodation, where occupants are not capable of independent evacuation from their flat, should be limited to 9 m, or an alternative exit should be provided that is suitable for the abilities of the occupants. **2. Protected stairways and corridor zones** When deciding on the dimensions of protected stairways and corridor zones, provision should be made for adequate refuge space for occupants to await further progressive evacuation in managed buildings. **3. Vertical transporation** Where it is deemed necessary to assist vertical evacuation, sufficient evacuation lifts should be provided to meet travel distance and vertical escape recommendations. **4. Furnished areas in corridors** Furnished areas may be provided within common corridors in accordance with figure below where there is on-site management control. Furnished areas in specialized housing corridors Key 1 Width of corridor maintained free from furniture (1.0 m min) 2 Area containing furniture Self-closing FD 30S fire door (double-leaving) Furnished area (30 m² max.) The furniture should confirm to the medium hazard resistance to ignition classification specified in BS 7176. Curtains in communal areas should meet the performance requirements for classification as Type B or Type C when tested in accordance with BS 5867-2:2008. **5. Electric wheelchairs and mobility scooters** Avoid charging points in common access corridors or protected stairways. Charging area should be separated from the means of escape by fire-resisting construction of not less than 30 mins.	Table 4 **Fire resistance periods for elements of structure (independent of ventilation conditions)** Condition / Minimum periods of fire resistance, in minutes Depth below access level of basement level: >10 m / ≤10 m Height of top occupied storey above access level: ≤5 m / ≤18 m / ≤30 m / >30 m Sprinklered [A1]: 90 / 60 / 30 / 60 / 60 / 120 Unsprinklered: 90 / 60 / 30 / 60 / 90 / Not allowed [A1] Sprinkler systems should be in accordance with BS 9251:2014 or BS EN 12845 (see 11.2, Table 2).	
3	BS 9999:2017	Not applicable to specialised housing. However, it might have only limited applicability to certain specialist buildings and areas of buildings (e.g. areas of lawful detention). Accordingly, retirement housing (independent living) comes under occupancy characteristics Ci.	Minimum acceptable detection and alarm system: For risk profile Ci 1 & 2 - automatic fire detection in individual units For risk profile Ci3 - L3 (BS 5839-1)	With sprinklers, the fire growth rate can be reduced, for example from medium to slow.	Progressive horizontal evacuation (PHE) is suitable means of evacuating disabled people in all occupancies. Travel distance requirements (max) with minimum fire protection measures: Risk Profile C1 - 2 way travel - 18 m (direct), 27 m (actual) - 1 way travel - 9 m (direct), 13 m (actual) Risk Profile C2 - 2 way travel - 12 m (direct), 18 m (actual) - 1 way travel - 6 m (direct), 9 m (actual) With automatic fire detection and fire alarm systems in the building, a 15% increase in allowable travel distance and a 15% reduction door width, corridor width and stair width is permitted. Similarly, with increased ceiling heights there are benefits. However, the maximum travel distance permitted for C1 risk profile in one-way travel is 18 m and for two-travel is 37 m. Similarly, for C2 risk profile the maximum travel distance permitted in one-way travel is 13 m and for two-travel is 27 m.	With automatic sprinkler systems in the building, the separation distance between building can be increased. Table 23 **Fire resistance periods for elements of structure (independent of ventilation conditions)** Risk profile / Minimum periods of fire resistance, in minutes Depth below access level of lowest basement: More than 10 m / Not more than 10 m Height [A] of top occupied storey above access level: Not more than 5 m / Not more than 18 m / Not more than 30 m / More than 30 m A1: 60 / 60 / 30 / 60 [B] / 90 [C] / 120 A2: 90 [C] / 60 / 30 / 60 / 90 / 120 A3: Not allowed / 120 [D] / 60 / 90 / 90 / 120 B1: 60 / 60 [B] / 30 / 60 / 90 [C] / 120 B2: 90 [C] / 60 / 30 / 60 / 90 / 120 B3: Not allowed / 120 [D] / 60 / 90 / 90 / 120 C1, C2 and C3 (not individual residential): 90 [C] / 60 / 30 / 60 / 90 [C] / 120 *NOTE 15 min fire resistance may be used for open-sided car parks above ground level and with a top occupied storey not more than 18 m above access level (increased to 30 min protecting vertical means of escape).* [A] Buildings above 30 m are not permitted unless they have sprinklers in accordance with BS 5306-2 or BS EN 12845 (see 30.2.2). [B] 30 min if sprinklers conforming to BS EN 12845 (new system) or BS 5306-2 (existing systems) are fitted. [C] 60 min if sprinklers conforming to BS EN 12845 (new system) or BS 5306-2 (existing systems) are fitted. [D] 90 min if sprinklers conforming to BS EN 12845 (new system) or BS 5306-2 (existing systems) are fitted.	
4	NFPA 101	Residential board and care - an occupancy used for lodging and boarding 4 or more residents, not related by blood or marriage to the owners or operators, for the purpose of providing personal care services. *Therefore, specialised housing and care home comes under Health Care Occupancy.* SMALL FACILITIES - sleeping accommodation for not more than 16 residents	Initiation of required fire alarm system shall be by one of the following means: (i) manual means (ii) automatic sprinkler system which provides protection throughout the building Smoke alarms - in all level including each sleeping room, living areas, basements CO detection and alarm systems	All facilities, other than those meeting the below paragraph, shall be protected throughout by an automatic sprinkler system (quick-response or residential sprinklers) In conversions, sprinklers shall not be required in small board and care homes serving 8 or fewer residents when all occupants have the ability as a group to move reliably to a point of safety within 3 minutes. Sprinklers need to be in accordance with NFPA 13 and initiate the fire alarm system.	Primary means of escape: (i) every sleeping room and living area shall have access to a primary means of escape located to provide a safe path of travel to the outside at street level or the finished ground level. (ii) where sleeping rooms or living areas are above or below the level of discharge, the primary means of escape shall be an interior stair, an external stair, a horizontal exit or a fire escape stair. Secondary means of escape: Sleeping rooms that have a door leading directly to the outside of a building with access to the finished ground level or to an exterior stairway shall be considered as meeting all the requirements for a second means of escape. Sleeping rooms shall not require secondary means of escape where the clinical needs of the residents require special security measures, provided all of the following are met: (i) the building is protected throughout with sprinkler system (ii) automatic fire alarm system (need to meet specific requirements) (iii) smoke detector installed in accordance with 32.3.3.4.8 If the above requirements are not met, for sleeping rooms and living areas in facilities without sprinkler systems shall have a secondary means of escape consisting of one of the following: (i) door, stairway, passage or hall providing a way of unobstructed travel to the outside of the dwelling at street or the finished ground level that is independent of, and remotely located from, the primary means of escape. (ii) passage through an adjacent non-lockable space independent of, and remotely located from, the primary means of escape to any approved means of escape. (iii) emergency egress window or doors (requirements mentioned in section 32.2.2.3.1. Interior stairs used for primary means of escape: Stairs to be enclosed with fire barriers having a minimum of 1/2 hour fire resistance. The entire primary means of escape shall be arranged so that occupants are not required to pass through a portion of a storey above or a storey below, unless that route is separated from all spaces on that storey by construction having a minimum of 1/2 hour fire resistance rating. In buildings 3 or fewer stories in height that are protected by an approved automatic sprinkler system, stair enclosures shall not be required, provided that a primary means of escape from each sleeping area is maintained that does not require occupants to pass through a portion of a lower floor, unless that route is separated from all spaces on that floor by construction having a 1/2 hour fire resistance rating. Stairs serving a maximum of 2 storeys in building protected by an approved automatic sprinkler system shall be permitted to be unenclosed.	Hazardous areas to be enclosed (specifically when it abuts a primary means of escape or a sleeping room) in enclosure with a fire resistance rating of not less than 1 hour OR automatic sprinkler system and a smoke partition to be provided located between the space and the sleeping area or primary escape route, provided that any doors in such separation are self-closing or automatic closing.	Multiple occupancies requirements are provided in NFPA 101 section 32.1.3 Frequency of inspection, testing and maintenance of sprinkler system is mentioned in section 32.2.3.5.8

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<td></td>
<td>LARGE FACILITIES - sleeping accommodation for more than 16 residents</td>
<td>Initiation of required fire alarm system shall be by one of the following means:
(i) manual means (ii) manual fire alarm box located at a convenient central control point under continuous supervision of responsible employees (iii) required automatic sprinkler system (iv) required detection system

Annunicator panel, emergency forces notification

Smoke alarms shall be installed inside every sleeping room, outside every sleeping area in the immediate vicinity of the bedrooms, and on all levels within a resident unit.

Smoke detection system - corridors and spaces open to the corridors. This system shall not be required in unenclosed corridors, passageways, balconies, colonnades, or other arrangements with one or more sides along the long dimension fully or extensively open to the exterior at all times.</td>
<td>All buildings shall be protected throughout by an approved automatic sprinkler system and provided with quick-response or residential sprinklers throughout.</td>
<td>Travel distance: from any point in a room to the nearest exit shall not exceed 76 m. Minimum width of the corridors not less than 1525 mm.</td>
<td>All permitted buildings need to be sprinklered.

Buildings of construction Type I (442) is permitted to have more than 12 storeys.
Buildings of construction Type I (332) is permitted to have up to 12 storeys.
Buildings of construction Type II (222) is permitted to have up to 12 storeys
Buildings of construction Type II (111) is permitted to have up to 3 storeys
Buildings of construction Type II (000) is permitted to have up to 2 storeys
Buildings of construction Type III (211) is permitted to have up to 2 storeys
Buildings of construction Type III (200) is permitted to have up to 1 storey
Buildings of construction Type IV (2HH) is permitted to have up to 2 storeys
Buildings of construction Type V (111) is permitted to have up to 2 storeys
Buildings of construction Type V (000) is permitted to have up to 1 storey

To learn about the terminology 442, 332 etc, see: *https://www.firehouse.com/home/article/10473349/an-important-feature-of-a-preincident-plan-is-the-classification-of-building-construction-classifying-the-type-of-building-should-be-simple-quick-and-strategically-relevant-the-classification-of-a-building-should-capture-important-strategic-information#:~:text=Type%20I%20(442%20or%20332,or%20limited%2Dcombustible%20materials.%22 to*

• Type I: (fire resistive).
• Type II: (non-combustible).
• Type III: (ordinary, or brick and joist).
• Type IV: (heavy timber).
• Type V: (wood frame).</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Practical Fire Safety Guidance for Care Homes, February 2014 Scotland</td>
<td>This guidance is applicable only to the existing care homes and is not a design guide for new built.

Care homes comprising either a ground floor, ground and first floor or ground, first and second floor, will fall within the scope of this guide. However, the benchmarks in this guide are unlikely to be appropriate for very small premises, registered as care homes, that are akin to dwellings and which may have only one or two residents.

Care homes which provide a service for the following categories of resident:
(i) older people
(ii) children and young people
(iii) people with learning disabilities
(iv) people with drug and alcohol problems
(v) people with mental health problems
(vi) people with physical and sensory impairment</td>
<td>Category L1 as per BS 5839-1
• Heat detectors which operate when a fixed temperature is reached (and may also respond to abnormal rate of rise of temperature). Heat detectors have a good performance in respect of false alarms but are not appropriate where the detection of smoke is required (such as in escape routes).
• Smoke detectors which detect the presence of smoke (either ionisation or optical type). They give a speedier response to most fires than heat detectors but have greater potential to generate false alarms. Smoke detectors within corridors and stairs should be of the optical type.
• Combustion gas detectors which respond to the gases produced in a fire such as Carbon Monoxide. They can be sensitive to smouldering fires, respond to many fires faster than heat detectors and have a good false alarm performance in the presence of dust, steam and cigarette smoke.
• Multi-sensor detectors contain a combination of heat, smoke or combustion gas detection. These sensors enhance system performance and have a low potential for false alarm actuations.

Manual call points

REMOTE MONITORING
267. With remote monitoring, the actuation of the fire warning system causes a signal to be transmitted automatically to a remote alarm receiving centre (ARC). On receipt of a signal, the ARC then calls the Fire and Rescue Service. An ARC arrangement is particularly suitable for care homes with high and/or medium dependency residents due to the competing demands on staff in the event of fire.</td>
<td>Requires an automatic life safety fire suppression system meeting recommendations for 'residential occupancies' contained in BS 9251

Water mist acceptable - BS DD 8458-1</td>
<td>Evacuation Strategy recommended - Progressive Horizontal Evacuation (PHE) or Immediate Evacuation
For care homes with high dependency residents, PHE will be the only realistic option due to the difficulty in moving residents and the extended evacuation time. Having a mix of low dependency and high dependency residents may allow easier evacuation.

Windows are not suitable as means of escape in a care home. An escape route should not be by way of a lift. Lifts should not be used for evacuation unless specifically designed for the purpose.

Unobstructed width of escape routes - atleast 1.2 m for highly dependent residents; at least 1 m for low dependency; at doorways the width can normally be reduced by 150 mm.

Table 6 – Travel Distance by Reference to Residents and Suppression
<table><tr><th>Dependency of resident</th><th>Suppression system</th><th>Single direction distance (m)</th><th>Maximum distance* (m)</th></tr><tr><td rowspan="2">High</td><td>No</td><td>9</td><td>18</td></tr><tr><td>Yes</td><td>12</td><td>25</td></tr><tr><td rowspan="2">Medium</td><td>No</td><td>12</td><td>25</td></tr><tr><td>Yes</td><td>15</td><td>32</td></tr><tr><td>Low</td><td></td><td>15</td><td>32</td></tr></table>* This includes the single direction distance.</td>
<td>**155.** The following benchmarks are relevant to compartmentation in premises where progressive evacuation is adopted:
• Floors are compartment floors so that every upper storey and every basement storey is a separate compartment;
• A storey area exceeding 1500m², sub-divided into separate compartments, each no greater than 1500m²;
• Compartments divided into at least two sub-compartments by a sub-compartment wall and door(s) so that each sub-compartment is no greater than 750m²;
• Fire-resistance of compartment walls, floors and doors at least 60 minutes, or in premises with only medium and/or low dependency residents where no residents are sleeping above the ground floor, at least 30 minutes; and
• Fire resistance of sub-compartment walls and doors at least 30 minutes.

 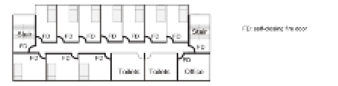
Figure 4 - Protected Bedroom Corridor

Table 5 - Surface Fire Spread by Reference to Room Use and Size and Resident Type
<table><tr><th>Dependency of the residents</th><th>Surface</th><th>Rooms less than 4m² (category)</th><th>Rooms 4m² to 30m² (category)</th><th>Rooms more than 30m² (category)</th><th>Protected stairs & corridors* (category)</th></tr><tr><td rowspan="2">High</td><td>walls</td><td>2</td><td>1</td><td>0</td><td>0</td></tr><tr><td>ceilings</td><td>2</td><td>1</td><td>1</td><td>0</td></tr><tr><td rowspan="2">Medium</td><td>walls</td><td>2</td><td>2</td><td>1</td><td>0</td></tr><tr><td>ceilings</td><td>2</td><td>2</td><td>2</td><td>0</td></tr><tr><td rowspan="2">Low</td><td>walls</td><td>2</td><td>2</td><td>2</td><td>1</td></tr><tr><td>ceilings</td><td>2</td><td>2</td><td>2</td><td>1</td></tr></table>* Includes any toilet or washroom within the enclosure of a protected stair.

159. The surface spread of fire grading system relates to performance against tests set out in certain British Standards. Examples of materials which may fall into these categories are:
Category 0 - brickwork, blockwork, concrete, ceramic tiles, plaster finishes (including rendering on wood or metal lathes), wood-wool cement slabs and mineral fibre tiles or sheets with cement or resin binding.
Category 1 - timber, hardboard, blockboard and particle board, which have been treated to achieve this category.
Category 2 - timber, hardboard, blockboard, particle board and certain dense timber or plywood.</td>
<td>The term 'dependency' is defined. 3 categories as follows:
(i) Low dependency - describes residents who have the physical and mental capability to respond to a fire emergency and exit the premises unaided or with minimal staff assistance
(ii) Medium dependency describes residents who either: (a) require physical assistance or guidance from a staff member to respond appropriately in a fire emergency; or (b) can exit the premises unaided, but will take an extended time to achieve this
(iii) High dependency: residents who are totally dependent on staff and may require the assistance of 2 or more staff members in a fire emergency

Mainetanance and testing of fire safety systems discussed in this guide

Preventive measures mentioned in detail in this guide</td>
</tr>
<tr>
<td>6</td>
<td>Fire Safety in Specialised Housing - NFCC</td>
<td>Specialised housing - recommendations relate to sheltered housing, extra care housing, supported housing for people with common characteristics such as learning disabilities and mental health problems</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Preventive measures, causes of fires in care homes, fire risk assessment etc. are provided in this guidance document. This provides more guidance when compared to other guidance documents looked here.</td>
</tr>
<tr>
<td>6.1</td>
<td></td>
<td>SHELTERED AND EXTRA CARE HOUSING - Recommended good practice and measures recommended to comply with Fire Safety Order</td>
<td>LD1 fire detection system - all rooms are protected with automatic fire detectors
Within each flat, there should be at least 1 smoke detector in the hallway. Smoke detector(s) in each flat should not give any other warning beyond the flat, but should be monitored by an onsite scheme manager (if present) and by an alarm receiving centre at all times when a scheme manager is not present. Monitoring by a Telecare system, whereby 2-way speech can be established between the alarm receiving centre and each flat, is preferred, so that false alarms can be filtered.
In schemes with communal facilities, there should be a communal fire alarm, but should not give an evacuation signal within flats.</td>
<td>Automatic sprinkler system or watermist - recommended as good practice</td>
<td>Travel distance between every flat entrance door and the nearest door to a final exit, stairway door or cross-corridor door should, ideally, not exceed 7.5 m, but, subject to risk assessment, this could be extended to around 10 m.

Smoke control arrangements should be sufficient to control means of escape.</td>
<td>Compartmentation between each flat, and between flats and the common parts, should generally afford 60 minutes fire resistance. Compartment walls on the top floor should extend through the roof void to the roof of the building.
Flat entrance doors should be self-closing and ideally afford 30 minutes fire resistance.
Surface finishes should be Class D.
Stairways should be enclosed in 30 mins fire resisting construction.

In existing blocks, where 60 mins fire resistance is not met, or cannot readily be achieved by upgrading walls or floors, compensatory fire protection measures may need to be considered which might include one or more of the following: (i) provision of enhanced automatic fire detection; or (ii) provision of an automatic water fire suppression system - sprinkler or watermist system.</td>
<td>Stay put evacuation strategy is recommended. Each living unit is considered as a compartment here.</td>
</tr>
<tr>
<td>6.2</td>
<td></td>
<td>SUPPORTED HOUSING - Recommended good practice and measures recommended to comply with Fire Safety Order</td>
<td>LD1 fire detection system - BS 5839-6 should be provided</td>
<td>Sprinkler and watermist protection is recommended for high risk supported housing</td>
<td></td>
<td>The requirement for compartment walls or floors in domestic dwelling houses within current design guides is limited to walls separating semi-detached houses, or houses in a terrace (party walls), and walls and floors separating internal garage from the remainder of the dwelling. Where required, the period of fire resistance of compartment walls and floors would be 30 mins where the height of the top floor above ground is not than 5 m; a period of 60 mins is necessary where the height of the top floor is over 5 m.

However, for compliance with current building regulations, all floors need to provide fire resistance. In terms of integrity, the fire resistance of floors in a 2 storey dwelling house need only be 15 mins, while this is increased to 30 mins in a 3 storey house, and to 60 mins in houses of more than 3 storeys.</td>
<td>If each living unit is considered as a compartment and design accordingly, a stay put evacuation policy is recommended. Else simultaneous evacuation can be considered.</td>
</tr>
<tr>
<td>7</td>
<td>Fire Safety Risk Assessment – Residential Care Premises</td>
<td>Guide only applies to England and Wales. It provides recommendations and guidance for use when assessing the adequacy of fire precautions in premises providing residential care. This guide is not intended to be used to design fire safety in new buildings. However, it can useful to develop the fire safety strategy for the building</td>
<td>In small homes, e.g. with no more than one floor above ground, accommodating up to four residents who do not need assistance to escape, a basic system based on mains powered interlinked smoke alarms with battery back-up may provide suitable protection.

In larger premises, where all the residents are capable of evacuating themselves without staff assistance, the system should include detectors in all the escape routes, in any room opening onto any escape route and in any other areas of high risk. BS 5839-1[9] gives guidance on category L2 systems, which are designed to provide this level of protection.

In other larger premises, particularly those accommodating more than ten residents above the ground floor, or where a significant proportion of the residents are dependant upon staff assistance to escape in the event of a fire, a more comprehensive system of detection covering all areas of the building described above would be appropriate. BS 5839-1[9] gives guidance on category L1 systems which are designed to provide this higher level of protection.</td>
<td>Sprinkler protection can give additional benefits, such as a reduction in the amount of portable fire-fighting equipment necessary or a relaxation of restrictions in the design of buildings (including the lengths of escape routes, the provision of fire-resisting barriers or the provision of some self-closing fire doors). There may also be additional benefits such aas a reduction in insurance premiums and a significant reduction in the risks of major disruption to your activities as a care provider.</td>
<td>Evacuation strategy - Progressive horizontal evacuation (PHE), single stage evacuation, delayed evacuation

Classify occupants based on their dependencies -
• **Independent:** the mobility of residents is not impaired in any way and they are able to physically leave the premises without the assistance of staff or, if they experience some mobility impairment, they are able to leave with minimal assistance from another person.
• **Dependent:** all residents except those defined as independent or very high dependency. This category also includes those with mental health problems regardless of their independent mobility.
• **Very high dependency:** those residents whose care and / or condition creates a high dependency on staff and where immediate evacuation would prove potentially life threatening.

Table 2 Suggested travel distances
<table><tr><th>Escape routes</th><th>Suggested range of travel distance</th></tr><tr><td>Where more than one escape route is provided</td><td>10m in higher fire-risk area(Note 1)
18m in normal fire-risk area
25m in lower fire-risk area(Note 2)</td></tr><tr><td>Where only a single escape route is provided</td><td>6m in higher fire-risk area(Note 1)
9m in normal fire-risk area
12m in lower fire-risk area(Note 2)</td></tr></table>Note 1: Where there are small high-risk areas the travel distance should apply. Where the risk assessment indicates that the whole building is high risk, ask advice from a competent person.
Note 2: The travel distance for lower risk premises should only be applied in exceptional cases in the very lowest risk premises.</td>
<td>If you have existing premises that are being used for residential care purposes for the first time, it is likely that upgrading of some structure will be required to support a policy of horizontal evacuation. For example, all floors should ideally have 60 minutes fire resistance, and a minimum of 30 minutes.

Basement fire protection and escape

As a minimum, any floor over a basement should provide 60 minutes fire resistance. Where this is impractical, and as long as no smoke can get through the floor, automatic smoke detection linked to a fire-alarm system which is audible throughout the premises could, as an alternative, be provided in the basement area. If in doubt, contact a competent person for more detailed advice.</td>
<td></td>
</tr>
</table>

Appendix 5 Literature Review by Innovation Fire

DELIVERING EXCELLENCE
INNOVATION FIRE ENGINEERING

STAGE 1 REPORT

Project Title	Care Home and Specialised Housing Research
Project Number	200739L
Engineer	Ayyappa Thejus Mohan
Checker	James Brady
Date	27.11.2020
Issue Number	2
Amendments	**Section 2 (a), (b), (c), (d), (e), (f), (n), 4 (g), 6; Table 1, 2**

CONTENTS

1. Introduction

a) This report is prepared as a part of research on Specialised Housing and Care Homes.

b) The research on Specialised Housing and Care Homes aims to ensure that Approved Document B (ADB) [1] provides adequate guidance for building types in scope to meet the minimum requirements under Schedule 1 Part B of the Building Regulations 2010.

2. Review fire safety guidance documents applicable to specialist housing and care homes

Herein, the main objective is to understand how other fire safety guidance documents* differ from the guidance in ADB. The summary of main findings and recommendations are discussed in this section:

*Note: The review mainly considers the fire safety guidance documents commonly adopted in the UK. This includes guidance documents for fire safety design, fire risk assessment and fire safety management in care homes and specialised housing. In addition, to understand the perspective of fire safety in similar occupancy types in the United States, the relevant NFPA code is also referred to.

a) ADB in general provides guidance on residential care homes. However, the specialised housing and care homes have a broader scope as it covers sheltered housing, extra care housing, supported housing for people with common impairments or disabilities, such as learning disabilities and mental health problems. In this regard, ADB requires additional guidance to be provided to fire engineers, architects and the enforcing authorities.

b) The scope of the various fire safety guidance documents referred for review is listed out in Table 1. The applicability of the documents based on their scope (i.e. new building, existing building and fire service operations) are summarized in Table 2.

Table 1 Scope of various documents referred

Guidance Document	Scope
ADB [1]	Residential care homes
BS 9991 [2]	Provides guidance for specialised housing such as sheltered housing. Note: Residential care home is outside the scope of BS 9991
BS 9999 [3]	Not applicable to specialised housing Do not provide guidance on occupancy characteristics 'D'. BS 9999 might have only limited applicability to certain specialist buildings and areas of buildings (e.g. areas of lawful detention). Accordingly, retirement housing (independent living) comes under occupancy characteristics Ci.
NFPA 101 [4]	Residential board and care - an occupancy used for lodging and boarding 4 or more residents, not related by blood or marriage to the owners or operators, for the purpose of providing personal care services.
NFCC Guidance on Fire Safety in Specialised Housing [5]	This document is a guide to ensuring adequate fire safety in existing (or converted to be used as) specialised housing. Although this guidance is primarily applicable to existing buildings, new specialised housing (governed by the Building Regulations 2010) once occupied, this guide is applicable. Recommendations relate to sheltered housing, extra care

	housing, supported housing for people with common characteristics such as learning disabilities and mental health problems
Scottish Practical Fire Safety Guidance for Care Homes [6]	This guidance is applicable only to the existing care homes and is not a design guide for new built. Care homes comprising either a ground floor, ground and first floor or ground, first and second floor, will fall within the scope of this guide. However, the benchmarks in this guide are unlikely to be appropriate for very small premises, registered as care homes, that are akin to dwellings and which may have only one or two residents. Care homes which provide a service for the following categories of resident: (i) older people (ii) children and young people (iii) people with learning disabilities (iv) people with drug and alcohol problems (v) people with mental health problems (vi) people with physical and sensory impairment
Fire Safety in Extra Care Housing in the UK [7]	Focus on fire avoidance and control strategies in Extra Care Housing developments implemented at design and construction stages
Fire Safety in Specialised Housing – Extra Care Housing [8]	Briefing notes updating fire safety design and operational guidance and recommendations associated with Extra Care Housing as included in BS 9991:2015
Home Fire Safety Risk Referral Matrix – London Fire Brigade [9]	Intended for use by all parties involved in the care and protection of vulnerable people as a guide to reduce the risk of death or injury from fire
Ageing Safely – Protecting an Ageing Population from the Risk of Fire in the Home [10]	Document that is the UK's Fire & Rescue Services' (FRS) strategy for meeting the challenge of protecting an ageing population.
Mobility Scooter Guidance for Residential Buildings [11]	Outlines considerations for responsible persons of residential buildings to establish the safe use, storage and charging of mobility scooters. It focusses on commonly found situations.
Fire Safety Risk Assessment – Residential Care Premises [12]	Guide only applies to England and Wales. It provides recommendations and guidance for use when assessing the adequacy of fire precautions in premises providing residential care. This guide is not intended to be used to design fire safety in new buildings. However, it can useful to develop the fire safety strategy for the building. Residential care premises include those where care is provided for: • the elderly or infirm; • children and young persons; • people with special needs such as those with learning disabilities or with mental or physical disabilities; and

	• people with addictions. This guide is not intended for use in: • sheltered accommodation, where no care is provided; • premises where the primary use is healthcare treatment, e.g. hospitals and other healthcare premises; and • single private dwellings where out-posted nursing care is provided

Table 2 Applicability of the guidance documents based on their scope

Guidance Document / Technical recommendation	Applicability		
	New buildings	Existing Buildings	Fire Service Operations
ADB	✓	×	✓
BS 9991	✓	✓ (1)	✓
BS 9999	✓	✓ (1)	✓
NFPA 101	✓	✓	✓
NFCC Guidance on Fire Safety in Specialised Housing	×	✓	✓
Scottish Practical Fire Safety Guidance for Care Homes	×	✓	✓
Fire Safety in Extra Care Housing in the UK	✓ (2)	×	×
Home Fire Safety Risk Referral Matrix – London Fire Brigade	✓ (3)	✓ (3)	×
Mobility Scooter Guidance for Residential Buildings	✓ (4)	✓ (4)	×
Fire Safety Risk Assessment – Residential Care Premises	-	✓ (5)	×

Notes:
(1) Material alterations, extensions and material change of use of an existing building.
(2) Focus on fire avoidance and control strategies in Extra Care Housing developments implemented at design and construction stages
(3) May be used for assessing the needs of vulnerable persons
(4) Useful for professionals who manage, provide advice or enforce standards in residential buildings and undertake fire risk assessment in such buildings.
(5) This guide is not intended to be used to design fire safety in new buildings. However, it can useful to develop the fire safety strategy for the building.

c) In general, for persons with physical and/or cognitive impairment, a longer evacuation time is expected. In care homes and specialised housings, there may be residents who exhibit severe mobility restrictions, but have good awareness of the situation and will co-operate with the staff. However, the pre-evacuation time for such occupants will be longer as initial response may involve considerable preparation time (prior to movement) [13]. On the other hand, the level of awareness of the occupants exhibiting normal mobility may be such that they present unpredictable behaviour, which may impede staff in an emergency. For example, residents living with dementia may become distressed by the sound of the alarm and the sudden activity [12]. This potentially results in longer evacuation times.

Therefore, considering longer evacuation time in care homes and specialised housings, installation of an automatic water fire suppression system (AWFSS) is beneficial. The benefits of automatic sprinkler systems in residential care homes are recognised in studies such as [14]. Similarly, guidance documents or technical recommendations such as [4, 5, 6, 9, 12] recommend an AWFSS in buildings housing

persons with physical and/or cognitive impairment. For example, the NFCC guidance on fire safety in specialised housing [5] recommends automatic sprinkler system or watermist system as a good practice in sheltered and extra care housing. Similarly, this guidance recommends sprinkler or watermist protection for high-risk supported housing. On the other hand, Scottish guidance for care homes [6] recommends automatic sprinkler or watermist systems. Similar is the case with NFPA 101 [4]. As per the guidance provided in ADB, automatic sprinkler system is not required in care homes if the protected areas contain less than 10 beds. i.e. ADB recognises the following benefits with addition of sprinklers:

- Bedroom fire doors need not be fitted with self-closing devices
- Protected areas may contain more than 10 beds
- Bedrooms may contain more than 1 bed

As per ADB even if a care home accommodates 9 beds in a protected area, with high and/or medium dependency residents, there is no requirement for sprinklers. However, in the night when the staff members will be less, it is questionable whether such care homes with high and/or medium dependency residents meet an adequate safety level. On the other hand, NFPA 101 takes into account such aspects. For example, NFPA 101 recommends the following in conversions (for small facilities i.e. sleeping accommodation for not more than 16 residents): "sprinklers shall not be required in small board and care homes serving 8 or fewer residents when all occupants have the ability as a group to move reliably to a point of safety within 3 minutes." All facilities not meeting this recommendation, shall be protected throughout by an automatic sprinkler system. Therefore, considering various benefits of sprinklers, it is recommended to take into account the level of assistance required for residents as a factor when deciding the provision of sprinklers in care homes and specialised housing.

d) The guidance provided in ADB lacks a clear distinction between residential care homes and sheltered housing or specialised housing. For example, ADB mentions the following with regard to residential care homes and sheltered housing:

- Residential care homes are quite diverse and can be used by a variety of residents, often requiring different types of care to suit their specific needs. They can include homes for the elderly, children and people who are physically or mentally disabled.
- Sheltered housing includes: (i) two or more dwellings in the same building; (ii) two or more dwellings on adjacent sites; where those dwellings are, in each case, designed and constructed for the purpose for vulnerable or elderly people who receive, or who are to receive, a support service.

From the above discussion, 'residential care homes' and 'sheltered housing' are similar since both accommodate vulnerable population groups. This further implies, there is a lack of clarity on different types of specialised housing (e.g. sheltered/retirement homes, extra care etc.) and care homes (e.g. residential homes, nursing homes etc.). However, a distinction is made between specialised housing and care homes in BS 9991 [2]. Therefore, it is suggested to incorporate a clear distinction as mentioned in BS 9991.

e) ADB only mentions that a Category L1 fire detection and fire alarm system designed and installed to BS 5839-1 [15] is required in residential care homes. Also, for sheltered housing with a warden or supervisor ADB recommends a connection of fire detection

system to a central monitoring point (or alarm receiving centre). Due to the above-mentioned lack of clarity in the distinction between residential care homes and sheltered housing in ADB, it can be argued that care homes will only require a Category L1 fire detection and fire alarm system (this is the requirement mentioned in 3.47 of ADB), and a connection of fire detection system to a central monitoring point (or alarm receiving centre) is not a minimum requirement.

However, it is important to provide guidance on methods to reduce the investigation time and to ensure early response of the staff members and/or fire service in care homes and specialised housing particularly when high and/or medium dependency residents are accommodated. For example, Scottish guidance for care homes [6] highlights that a remote alarm receiving centre (ARC) is particularly suitable for care homes with high and/or medium dependency residents due to the competing demands on staff in the event of fire. Similarly, the NFCC guidance on fire safety in specialised housing [5] mentions that in sheltered and extra care housing, the fire detection and alarm system should be monitored by an onsite scheme manager (if present) and by an alarm receiving centre at all times when a scheme manager is not present. In 24/7 staffed care homes and specialised housing, to reduce investigation time and to ensure early response of the staff members, fire pagers designed and installed to BS 5839-1 [15] will be beneficial.

f) ADB mentions only about Progressive Horizontal Evacuation (PHE) and simultaneous evacuation strategy in residential care homes. However, with adequate compartmentation, 'stay-put' evacuation policy can be adopted in care homes and specialised housing. However, compartmentation is key in such cases. Such guidance is provided in NFCC guidance on fire safety in specialised housing [5] as mentioned below.

- When a fire occurs within a flat, the occupants alert others in the flat, make their way out of the building and summon the fire and rescue service.
- If a fire starts in the common parts, anyone in these areas makes their way out of the building and summons the fire and rescue service.
- All other residents not directly affected by the fire would be expected to 'stay put' and remain in their flat unless directed to leave by the fire and rescue service.

In care homes and specialised housing with high and/or medium dependency residents, this evacuation strategy is appropriate provided there are means of alerting the staff and residents of a fire at the earliest time.

Similarly, 'delayed evacuation' is a suitable evacuation strategy in care homes as indicated in [12]. i.e. in care homes where it is difficult to dangerous to get all semi-ambulant and non-ambulant residents into an adjoining protected area, or to a refuge during the initial stage of the evacuation, 'delayed evacuation' is a suitable evacuation strategy. However, it is important to have an enhanced structural fire protection to the individual living units and a suitable evacuation plan.

There are few issues related to the proposed evacuation strategies in ADB for care homes as mentioned overleaf:

- Simultaneous evacuation of the whole building in reality will be possible only with sufficient staff members, especially when people requires assistance during evacuation. Particularly, in the night when the staff members will be less, the extent to which the simultaneous evacuation strategy ensures reasonable level of safety of the residents is questionable.
- PHE is a better evacuation strategy compared to simultaneous evacuation in residential care homes. However, if most of the residents within a protected area requires assistance during evacuation, it is unlikely that all persons within a protected area could be evacuated to the adjoining protected area within 2.5 minutes, which is the flow time on which exit widths are specified in ADB [14].

Sheltered housing and extra care housing schemes are generally designed and constructed similar to purpose-built blocks of flats. For example, in relation to means of escape and compartmentation, BS 9991 mentions that specialised housing should be designed as self-contained flats. Moreover, for specialised housing with a warden/scheme manager service or with specialist support, further recommendations related to means of escape are provided in BS 9991. In such building designs, a 'stay-put' evacuation procedure as indicated in NFCC guidance on fire safety in specialised housing [5] is applicable. There are few issues considering the evacuation in sheltered housing and extra care housing schemes designed as block of flats as mentioned below:

- The common corridors are assumed to be maintained sterile and in case a fire occurs within the common parts, it is unlikely to spread beyond the immediate vicinity. However, compared to BS 9991, ADB does not provide any recommendations on furniture within the corridors, and the electric wheelchairs and mobility scooters (i.e. electric charging points and storage not to be located in common access corridors or protected stairways).
- Account needs to be taken on the nature of the residents. For example, residents with mobility and health issues might require more time to reach a place of reasonable safety (e.g. protected stairway, adjoining protected area) within a floor along a corridor. Therefore, the travel distance from a flat or living unit entrance door to a place of reasonable safety needs to be limited compared to a normal residential flat. In this regard, ADB recommends a maximum travel distance of 9 m in single direction for purpose group 2 (a). On the other hand, in the context of specialised housing, BS 9991 mentions a maximum travel distance of 7.5 m along a corridor from the flat entrance door where occupants require assistance for evacuation.

For progressive horizontal evacuation (PHE) strategy mentioned in ADB, high reliance is placed on compartmentation. Similar is the case when 'stay-put' and 'delayed evacuation' strategies are adopted. However, fire incidents mentioned in [14] indicates that a number of residents have died due to smoke inhalation in multiple fatality incidents. i.e. failure of compartmentation is visible in these incidents. Table B.7 of PD 7974-7 [16] indicating the extent of damage in USA fire incidents from 1989-1994 is shown in Figure 1. This indicates that with proper detection system, sprinkler system and fire resisting construction, 95% of the fires constrained to the room of fire origin. Although, this is based on old fire incidents in the USA, it is reasonable to consider these values at the present time taking into account the following:

- Enhanced fire detection and fire alarm technology
- Enhanced fire suppression systems
- Fire resisting construction in modern buildings
- Fire safety management in residential care homes and specialised housing

Table B.7 — *Extent of Damage in USA Fire Incidents, 1989-1994*

Protection	% constrained to room of origin	% constrained to floor of origin	% involving the full structure
None	59	4	37
Detection (D)	85	4	11
Sprinklers (S)	89	3	8
Fire resisting construction (FRC)	77	4	19
D+S	92	2	6
D+FRC	92	3	5
S+FRC	91	3	7
D+S+FRC	95	2	3

NOTE See Evaluation of Fire Safety Design Alternatives [28].

Figure 1 Table B.7 of PD 7974-7:2019 [16]

Moreover, to quantify the impact of sprinklers and better understand the benefits of automatic fire suppression in terms of the conditions within a typical residential care building, a fire and smoke modelling study was undertaken by Arup Fire[1] [14]. The study concludes that if fire suppression systems are provided in a residential care premises, they can assist in reducing the risks from fire, particularly if other fire safety measures (for example, passive fire protection) fail to act as intended. In addition, the study concludes that the adoption of an automatic fire suppression system within residential care premises is considered a cost-effective means of providing an improved level of safety. Similar benefits can be achieved in specialised housings as discussed earlier in section 2(c). Therefore, it is important to incorporate active fire suppression systems such as sprinklers or watermist in specialised housing and care homes. This will help to ensure a reasonable level of safety even with the failure of compartmentation in the room of fire origin.

g) NFCC guidance on fire safety in specialised housing is an excellent guide providing guidance on various fire safety aspects that need to be considered in the specialised housing. It provides guidance on preventive measures and cover various aspects that a fire engineer needs to consider in design. However, in the view of Grenfell tower fire, it requires more guidance on external fire spread issues.

h) Although, the Scottish Practical Fire Safety Guidance for Care Homes focusses on existing care homes, one highlighting part of this document is that it classifies a resident's ability to understand and physically respond to a warning of fire into 3 groups as indicated in Table 3.

[1] The layout of the building modelled is inline with ADB

Table 3 3 categories of dependency

Dependency	Description
Low	Residents who have the physical and mental capability to respond to a fire emergency and exit the premises unaided or with minimal staff assistance
Medium	Residents who are either: (a) require physical assistance or guidance from a staff member to respond appropriately in a fire emergency: or (b) can exit the premises unaided, but will take an extended time to achieve this
High	Residents who are totally dependent on staff and may require the assistance of two or more staff members in a fire emergency

The advantage of the above classification is that it helps to provide guidance on travel distance requirements in specialised housing and care homes based on the occupant characteristics and suppression system. For example, see Figure 2, which provides a snapshot of a table provided in the Scottish Practical Fire Safety Guidance for Care Homes.

Dependency of resident	Suppression system	Single direction distance (m)	Maximum distance* (m)
High	No	9	18
	Yes	12	25
Medium	No	12	25
	Yes	15	32
Low		15	32

* This includes the single direction distance.

Figure 2 Travel distance by reference to residents and suppression – adopted from [6]

i) Fire resistance requirement specified in ADB for institutional buildings is indicated in Figure 3.

Table B4 Continued

Purpose group of building	Minimum periods of fire resistance[1] (minutes) in a:						
	Basement storey* including floor over		Ground or upper storey				
	Depth (m) of the lowest basement		Height (m) of top floor above ground, in a building or separated part of a building				
	More than 10	Up to 10	Up to 5	Up to 11	Up to 18	Up to 30	More than 30
2. Residential							
a. Institutional	90 min	60 min	30 min[2]	60 min	60 min	90 min	120 min[3]

Figure 3 Minimum period of fire resistance – adopted from ADB[2]

Even without a sprinkler system in care homes, a care home having top floor up to 5 m above ground requires only 30 minutes of fire resistance as per ADB. However,

[2] This is reproduced from the recent 'Amendments to the Approved Documents' published by HM Government – May 2020

considering the dependency of residents and longer evacuation time, the extent to which this requirement ensures a reasonable level of safety is dubious. In this regard, adopting a classification based on dependency of residents helps to better specify the fire resistance requirements. For example, the Scottish Practical Fire Safety Guidance for Care Homes mentions that fire-resistance of compartment walls, floors and doors need to be at least 60 minutes, or in premises with only medium and/or low dependency residents where no residents are sleeping above the ground floor, at least 30 minutes fire resistance is required.

j) Emergency escape windows are not a suitable means of escape for the vulnerable population groups. This needs to be highlighted in the fire safety guidance document. This will further ensure that fire engineers consider sufficient means of escape and avoid using an emergency egress windows as an alternative means of escape in specialised housing and care homes.

k) BS 9991, when compared to ADB guidance, provides more points on specialised housing. However, it is important to note that BS 9991 is not suitable for residential care homes. NFCC guidance fills these gaps to a certain extent. BS 9991 provides clear guidance on furnished area in corridors of specialised housing and electric wheelchairs and mobility scooters. However, recent studies on fire safety issues of the mobility scooters need to be looked into further as given in Mobility Scooter Guidance for Residential Buildings [11].

l) Following BS 9999 approach for a risk profile of C2 or C1 which is applicable to retirement housing (independent living), it is important to have further discussions before such guidance is to be considered incorporating to ADB. This is due to the fact that with the inclusion of sprinklers or additional fire protection measures (such as enhance fire detection and fire alarm system, increased ceiling height), there are benefits possible such as increasing the travel distance, reducing the width of the doors, stair widths etc. to a certain extent.

m) The referred guidance documents need to better explain whether residents tamper with the installed fire safety system in specialised housing and care homes. If so, the guidance documents need to provide guidance on measures that need to be adopted to prevent such issues. The extend of such issues and any measures to reduce such problems need to be studied.

n) To conclude, some of the key points based on the review of different fire safety guidance documents indicated in Table 1 are mentioned below:

- ADB provides only limited guidance on care homes. There is a lack of clarity between care homes and specialised housing. In this regard, BS 9991 gives a better picture. Similarly, BS 9991 discusses furnished area in corridors of specialised housing and electric wheelchairs and mobility scooters.
- ADB does not mention or provide guidance on other possible evacuation strategies such as ‘stay-put’ and ‘delayed evacuation’. It is also important to highlight pre-requisites for considering such strategies in care homes and specialised housings.
- ADB does not provide guidance on methods to reduce the investigation time and to ensure early response of the staff and/or fire service in care homes particularly when high and/or medium dependency residents are accommodated.

- NFCC guide on fire safety in specialised housing provides an excellent overview of various aspects of fire safety to be considered in specialised housing. However, many of the discussions in this guide are considered to be relevant to care homes.
- Scottish guidance for care homes classify occupants based on the level of 'dependency'. This is a good approach to follow. Also, the travel distance requirements are mentioned clearly considering the level of dependency required and the fire suppression systems in the building. In addition, recommendations for fire prevention, and testing and maintenance of fire safety systems are provided in this guidance document.
- NFCC guide on fire safety in specialised housing provides guidance on person-centred fire risk assessment.
- NFPA 101 provides recommendations on frequency of inspection, testing and maintenance of fire safety systems in care homes. It also recommends an automatic sprinkler system: quick-response or residential sprinklers (NFPA 13).

3. Collate evidence from PRP's existing library and from other publications

This section of this report provides the details of publications and research that need to be collected as a part of research on Specialised Housing and Care Homes.

a) Harpur A., Boyce, K., Mcconnell. N. An investigation into the circumstances surrounding elderly dwelling fire fatalities and the barriers to implementing fire safety strategies among this group. Fire Safety Science, 11 (2014). pp. 1144-1159

This study is based on the research of all fatal dwelling fires that occurred in Northern Ireland during the period 1999-2009. The elderly were less likely to have alcohol play a role in their death, more likely to be involved in fires where their clothing was the seat of the fire, have physical illness play a role, and have burn injuries as their primary cause of death. The most concerning result from this study is the minimal attention given to how elderly householders, especially those with poor mobility, would escape in the event of a fire.

b) Fire Safety and the Ageing Population (2016), Arnhem: Instituut Fysieke Veiligheid (IFV)

This study is based on the study in Netherlands. The study discusses on the extent of the problem, risk factors (such as persons with physical and mental restrictions or impairments have an increased chance of fire and burns, living along and social isolation form an additional fire hazard among the elderly, smoking and cooking are the biggest causes of fire for these under 65 as well as those over 65 years of age) and their causes and solution strategies (make direct surroundings of the elderly as fire-resistant as possible, smoke detectors linked to alarm response services, provision of sprinklers etc.).

c) Building Research Establishment (BRE) 2006, Sprinkler Effectiveness in Care Homes

This report is concerned with care homes for the elderly. A smoke alarm fitted in the room will provide early warning of a fire and alert the occupant and nursing staff to the problem. In most situations where a sprinkler operates, other occupants within the room should survive. However, many of the findings are relevant to other types of care home.

d) Runefors, Marcus & Johansson, Nils & Van Hees, Patrick. (2017). The effectiveness of specific fire prevention measures for different population groups. Fire Safety Journal. 91. 10.1016/j.firesaf.2017.03.064

An analysis of fire statistics and data based on fire investigations reports in Sweden is performed in this paper in order to provide recommendations for how different preventive measures can be targeted effectively. It is seen that the effectiveness of different preventive measures depends on age, gender, occupancy type, whether an individual is living alone and whether the individual is a smoker.

e) Fernández-Vigil, M., Gil Rodríguez, B. & Echeverría Trueba, J.B. Fire Safety Strategies to Reduce Mortality in Dwellings Occupied by Elderly People: The Spanish Case. Fire Technology 56, 2257–2281 (2020). https://doi.org/10.1007/s10694-020-00972-4

This study is done in Spain. The study discusses on useful fire prevention strategy for the elderly people. Most important measures were found to be fire detection and alarm system and automatic extinguishing systems such as sprinklers. It is also found that the use of safe heating systems, avoiding old and bad-maintained portable heaters, is a particularly useful prevention strategy for the elderly people.

f) Runefors, M. (2020). Fatal Residential Fires: Prevention and Response. Lund: Lund University, Department of Fire Safety Engineering

Group-specific effectiveness of different fire safety measures is discussed in this thesis. The study is largely based on the Swedish data. The results indicate that smoke alarms are effective for most groups, but additional measures are needed for some groups. This is particularly true for older adults, for whom synthetic clothes and detector-activated sprinklers are highly effective.

g) Dementia Institute (BUDI) (2015), Fire Safety Innovations for People Affected by Dementia, Report on Focus Group and Survey findings, November 2015

This document touch upon the fire risk reduction strategies in the homes of people with dementia. This study is based on the UK data. 4 risk reduction strategies: a person-centred approach; partnerships to identify vulnerable households; assistive technology in the home environment; and dementia aware prevention strategies. People with dementia and family carers identified installing smoke and carbon monoxide detectors as a way of staying safe at home.

h) Williams C., Effectiveness of Sprinklers in Residential Premises, BRE project report 204505, BRE, 2004

Effectiveness of Sprinklers in Residential Premises is explored in this report. It is found that in most of the experiments conducted, the addition of residential sprinkler protection proved effective in potentially reducing causalities in the room of fire origin and connected spaces. Also, smoke alarms, fitted in the room of fire origin, responded typically in half the time required by sprinklers and well before the conditions had become life threatening. Residential sprinklers are probably cost-effective for residential care homes.

i) Arup Fire, British Automatic Fire Sprinkler Association (BAFSA) (2006). Sprinklers for Safer Living – The Benefits of Automatic Fire Suppression Systems in Residential Care Premises

This study reviews the following:

- *The identification of the risks associated with residential care premises;*
- *The direct and indirect consequences of a fire in residential care premises;*
- *The recommendations within current fire safety guidance documents in the UK and internationally;*
- *Automatic fire suppression;*
- *Alternative solutions;*
- *A fire modelling study to quantify the benefits that automatic fire suppression provides in residential care premises*

It is seen that the adoption of an automatic fire suppression system within residential care premises is considered a cost-effective means of providing an improved level of safety and can be used to compensate for other areas of the design when all relevant factors are considered.

j) Optimal Economics (2017). Efficiency and Effectiveness of Sprinkler Systems in the United Kingdom: An Analysis form Fire Service Data. https://www.nationalfirechiefs.org.uk/write/MediaUploads/NFCC%20Guidance%20publications/Protection/Efficiency_and_Effectiveness_of_Sprinkler_Systems_in_the_United_Kingdom-Supplementary_Report.pdf

This study looks into all primary fires between 2013 and 2018 in the UK and assess the impact of sprinklers on fire fatalities and injuries. It is seen that the performance effectiveness of sprinkler system was 99% across all building types and the operational reliability of the systems was 94%.

k) Folk, Lauren & Gonzales, Kiara & Gales, John & Kinsey, Michael & Carattin, Elisabetta & Young, Tim. (2020). Emergency egress for the elderly in care home fire situations. Fire and Materials. 10.1002/fam.2820

This study is based upon the observation of nine fire drills at six Canadian long-term care (LTC) and retirement homes. This study aims to address the specific data and knowledge gap: emergency egress of the elderly. Study helps in the aspects of evacuation modelling. The drills demonstrated that emergency egress in LTC and retirement homes is highly staff dependent with 72% of residents recorded requiring full assistance at all stages of movement in evacuation.

l) Rahouti, Anass & Lovreglio, Ruggiero & Gwynne, Steve & Jackson, Phil & Datoussaid, Selim & Hunt, Aoife. (2020). Human behaviour during a healthcare facility evacuation drills: Investigation of pre-evacuation and travel phases. Safety Science. 129. 10.1016/j.ssci.2020.104754.

This study is based on the evacuation of an outpatients' area of a public hospital in Auckland, New Zealand during two unannounced fire drills. The study looks into the evacuee reactions and actions of staff and patients' interaction during the evacuation process. Moreover, the study provides data on evacuee horizontal travel speed. The results showed that pre-evacuation time of patients ranges from 8 to 63 s; while, pre-evacuation time of staff ranges from 8 to 141 s. In addition, during the movement phase, staff who were not assisting patients, and patients with no impairments, travelled at a similar average walking speed (i.e. 1.06 m/s for staff members and 0.93 m/s for patients with no impairments). Finally, the results indicated that the average travel speed of patients with walking impairments and staff assisting them was almost half of the travel speed of the first two groups (i.e. 0.52 m/s).

m) Friesinger, J.G., Topor, A., Bøe, T.D. et al. The ambiguous influences of fire safety on people with mental health problems in supported housing. Palgrave Commun 5, 22 (2019). https://doi.org/10.1057/s41599-019-0230-0

This study is based on the fieldwork conducted in seven different Norwegian support housing settings in 2017 with 105 participants. The study shows that tenants may have negative experiences of reinforced fire safety and inappropriate installations, such as the fire alarm call point in the living room, that make them feel abnormal.

n) Proulx, G (2002), Evacuation Planning for Occupants with Disability, Internal Report No. 843, Fire Risk Management Program, Institute for Research in Construction, National Research Council Canada. Available at: https://nrc-publications.canada.ca/eng/view/ft/?id=3dc0fc00-e0f0-403f-9f5a-adac7edd7ca3

The report discusses on fire safety planning, building characteristics, complementary procedures and occupant characteristics. Moreover, this report highlights that a combination of different options needs to be considered to ensure an acceptable level of life safety for all occupants in the building and in general there is no single life safety option that will solve all the problems.

o) Shields, T.J., Smyth, B., Boyce, K.E. and Silcock, G.W.H. (1999), "Towards the prediction of evacuation behaviours for people with learning difficulties", Facilities, Vol. 17 No. 9/10, pp. 336-344. https://doi.org/10.1108/02632779910278746

This is a report published in 1999. However, it is worth looking into this study as it discusses on the evacuation behaviours for people with learning difficulties. It is seen that a resident evacuation capability technique for people with mental disability would assist facilities managers with difficulty of resource allocation and evacuation prioritisation.

p) Sørensen, JG 2014, Evacuation of People with Visual Impairments. DTU Byg Report, vol. R-314, Technical University of Denmark, Kgs. Lyngby.

The thesis looks into the data on evacuation characterises of vulnerable people and with a special focus on blind and visually impaired people. It is found that building elements such as stairs, signage, doors etc. challenge the movement for occupants having an impairment. For visually impaired person, it is easier to follow a predictable and intuitive layout of a building with even surfaces, and easy identifiable exit paths than a complex layout without guiding lines. Recognisable and easy to find emergency exits are preferred. It is also important to avoid obstacles in the egress route.

q) Hoskins B L, Helmberger D C (2017), Fire Alarms and At-Risk Populations, Oklahoma State University. Available at: https://www.nfpa.org/News-and-Research/Data-research-and-tools/Detection-and-Signaling/Fire-Alarms-and-At-Risk-Populations

This project gathers additional information on how fire alarm notification signals impact high risk populations by conducting targeted interviews with experts (e.g. teachers, therapists, etc.). This report concludes that fire alarm notifications will need to change in order to aid in more efficient evacuations for these at-risk populations, and additional evaluation and field trials need to be conducted in order to obtain more data to recommend code changes.

r) Purser, David. (2015). Fire safety and evacuation implications from behaviours and hazard development in two fatal care home incidents: FIRE SAFETY AND

EVACUATION IMPLICATIONS FOR CARE HOMES. Fire and Materials. 39. 430-452. 10.1002/fam.2250.

Two fatal care home fire incidents are analysed. Main conclusion of the study are as follows: With well-trained staff, safety can be provided by fire-resisting construction, incorporating sub-compartments with few bedrooms and free-swing, fire-rated doors, with smoke seals and automatic closure. These protect all occupants beyond the fire enclosure so that members of the staff are free to attend those immediately affected. Sprinklers provide further protection, particularly for occupants and members of the staff near the fire.

s) Pichler, J., Tannahill, R., and Gales, J (2015), Architectural Considerations for Egress in Nursing and Long-Term Care Homes. Sixth International Human Behaviour in Fire Symposium. Cambridge, UK. 649 -654. Available at: https://www.researchgate.net/profile/John_Gales/publication/305506201_Architectural_Considerations_for_Egress_in_Nursing_and_Long_Term_Care_Homes/links/5792765608aec89db7852cd1/Architectural-Considerations-for-Egress-in-Nursing-and-Long-Term-Care-Homes.pdf

This paper outlines the challenges presented when egressing nursing and long-term care homes, and how they could be improved by considering proper architectural design. Preliminary recommendations include designing and constructing nursing and LTC homes with a minimum number of storeys. By doing so, the staff members response time will be reduced. Also, rigorous fire safety training is vital for staff members in nursing and LTC homes.

t) CS Development Team (2015), Assisted Living Technology Catalogue. Available at: https://www.london-fire.gov.uk/media/2238/1-assisted-living-technology-catalogue.pdf

This report provides recommendations on various assisted living technology that could help support the independence, wellbeing and safety of individuals. See Section 5.

4. Occupant Characteristics and Fire Safety Systems

a) Studies on fire safety and the ageing population in the UK and the Netherlands indicate that when considering the care home fire safety, the factors mentioned in Table 4 are to be considered. These factors indicate the risk of becoming a dwelling fire fatality for elderly persons.

Table 4 Risk factors for elderly population

Country	Reference	Risk Factors
UK	[17,18]	Rate of fire-related fatalities (death per million people) generally increases with age. Men 80 years and over had the highest fire-related fatality rate of any demographic. The most at-risk elderly fatalities lived alone, were smokers and/or problem drinkers and had health conditions that affected mobility or cognitive function.
Netherlands	[19]	The riskiest situations are: • A single person • Male • During the winter • Who smoke and consumes alcohol • Is less mobile • Is in a small living space • With lots of furniture and stuff • Makes use of electric or gas heaters • Does not have a working smoke detector in the house

b) In general, some residents in the specialised housing and care home will require assistance from staff to evacuate, should a fire occur in the building. Other residents will be able to evacuate independently. Some residents, e.g. those living with dementia, may need more assistance that other elderly residents in the care home.

c) There may be residents who exhibit severe mobility restrictions, but have good awareness of the situation and will co-operate with the staff. On the other hand, the level of awareness of the occupants exhibiting normal mobility may be such that they present unpredictable behaviour, which may impede staff in an emergency. For example, residents living with dementia and autism may become distressed by the sound of the alarm and the sudden activity.

d) The inability to escape unaided and the unpredictable behaviour of the residents is likely to result in a reduced ability to escape during the early stages of fire development and increased evacuation times.

e) Autism - Persons with autism is reported to exhibit the following characteristics in relation to the fire alarms [20][3]:

- Loud audible notifications can cause students to become confused, scared and un-cooperative;
- Common occurrences during these emergencies are the student hiding in corners, under desks, or completely ignoring any instructions;
- Bright strobe lighting can also have adverse effects on these individuals.

f) Epilepsy – Epilepsy is a seizure disorder which can occur due to following factors [20]:

- Sleep deprivation
- Flashing bright lights

[3] These results are based on a study conducted in the USA for students having autism, epilepsy and other disabilities.

- Unusual amounts of stress
- Poor eating habits
- Different medication uses and other food products

In terms of fire safety systems, the bright flashing strobes and the frequency is a point to consider as it could affect the individuals with epilepsy.
The study [20] indicates that common bright white strobes is harsh and distracting. By slowing down the frequency of the strobe and changing the colour (blue or green), it may be possible to allow a calm and stimulating effect.

g) Dementia – a discussion on the characteristics of people with dementia is provided in [21]. This discussion indicates that the people with dementia fiddle with appliances or leave them on for a long time due to weak memory. In addition, such individuals are reported to have sensory challenges (sight, smell, taste, hearing and touch). The study indicates that people with dementia are likely to be involved in accidental dwelling fire confined to one room or more than one room, and fire fatalities amongst this group are often linked to smoking and cooking.

4 types of fire risk were identified by fire service participants and professionals working with people with dementia as listed below:

- Related to a person's past role or actions – for example, a professional (electrical engineer) with dementia attempting to fix electrical problems by disconnecting light fixings and leaving bare wires hanging from the ceilings.
- Using appliances inappropriately – for example, putting inappropriate items in the microwave
- Related to memory impairment or stress – for example, forgetting to turn heaters off.
- Person's home environment and situation – for example, over loaded plug sockets or extension cables or sitting too close to a fire

In addition, this study highlights the importance of a person-centred approach and concludes that assistive technology such as telecare should be introduced as early as possible. However, a key challenge is to ensure that the installation of technology in a person's home does not have a catastrophic unintended consequence of causing harm.

h) A field study conducted in seven Norwegian supported housing in 2017 with 105 participants (29 tenants, 70 staff, 5 managers and 1 planner) [22] highlights the negative experiences of fire safety – annoyance and irritation.

- Annoyance with frequent false alarms – one of the reasons for the frequent false alarms is the resident's tendency to simply test the functionality of the detector by smoking near it or malicious operation of the manual call point;
- Suspicious of the visual alarm unit in their living unit;
- Feeling of being monitored by the smoke detectors which frequently blinks to signal proper function;
- Feeling of being under surveillance, in particular by the emergency light that indicated the emergency exits in the event of a fire;
- Residents getting paranoid due to the blinking smoke detector or emergency light.

Response of the residents were as following:

- Placed masking taper over the LED bulb of the smoke detector to conceal the blinking light;
- Removed the internal parts of the detector and put the empty case back in the ceiling;
- Put plastic bags or plastic gloves over a sensitive and annoying smoke detector to disable it;
- Pulling out concealed sprinklers to see what was behind them – however, in general sprinkler was not a cause of concern.

This study by Friesinger et al. [22] provides some recommendations to turn a negative experience into a positive one:

- To avoid unnecessary annoyance – install smoke detectors without blinking LED lights and place them appropriately in ceilings to avoid false alarms;
- Tenants should be offered a safe good-quality home that is not decreased by the design of fire safety devices or by fire resistant materials, which make tenants feel abnormal or marginalized. For example, the stove guard is a good option;
- Health care professionals should balance house rules and tenants' own responsibility for preventing domestic fires, which is framed by the installed fire alarm system;
- Tenants' experiences should be heard in planning and organizing supported housing, including fire safety.

Another solution to the above problem is providing awareness. For example, if the above issues are identified in the living units, it is best to provide awareness to the residents on its importance and how it works. They should be convinced to feel that they are not being monitored.

i) A recent study on emergency egress for the elderly in care home fire situations [23] in Canada involved observations of 9 fire drills conducted at 6 Canadian long-term care (LTC) and retirement homes. These drills demonstrated that emergency egress in LTC and retirement homes is highly staff dependent with 72% of residents recorded requiring full assistance at all stages of movement in evacuation. Considering this fact, Personal Emergency Evacuation Plan (PEEP) will need to be prepared for the identified residents who will require assistance during an evacuation in the specialised housing and care homes. This will help the trained staff members to assist such residents during an evacuation without much delay. All staff need to be provided with instructions, training and information relating to the fire safety measures in the building and the procedures they should following in the event of fire.

j) In short, the following factors indicated below influence the time required to evacuate residents care homes [12] (these factors are also relevant to specialised housings):

- The degree of mobility of each resident to be moved;
- The level of awareness of each resident, and the level of co-operation that may be expected;
- The distance to be travelled to the nearest designated place of safety within the building;
- The number of staff members available to move residents;
- The level of training given to staff in moving residents quickly in an emergency; and

- The need to disconnect any medical devices and to prepare residents for further evacuation

5. Recent Advances in Science and Technology

This section of the report summarises assistive technology that would be beneficial in specialised housing and care homes in the perspective of fire safety. The main document referred here is the assisted living technology catalogue [24] and the relevant products are reproduced from this guide below.

a) (Specialist) Carbon Monoxide Alarm – for the hearing impaired. CO alarms should be connected with either radio LINK mains alarm panel which includes strobe and vibrator, a pager and charger, a wrist receiver, or a Wi-safe remote warning handset to alert the user that the detector has been activated. The type of additional device will depend on the make of the alarm. The detector is not for fire but may actuate in the event of a fire.

b) Detectors to Turn off an Electric Cooker - Useful for those with instances of forgetfulness rooted in cognitive issues. These detectors are designed to turn off an electric cooker if it is left on and work by turning the cooker off after a pre-set time and/or when they sense a certain temperature. These detectors must be fitted by an electrician.

c) Fire Retardant Bedding - Fire retardant bedding is a replacement for existing bedding and reduces the risk of fire starting on a bed, should a cigarette or match be dropped.

d) Fire Retardant Furniture Throws - Whilst the ideal is that everyone should have furniture that complies with Furniture and Furnishings regulations, many individuals won't. Therefore, if Fire retardant furniture throws are used to cover the settee, armchairs and chairs to protect against a fire starting on the furniture. However, like fire retardant bedding, a fire-retardant throw is not a fire proof item and does not remove the risk of fire entirely, it only reduces the risk.

e) Fire Retardant Nightwear - Fire retardant nightwear protects against a fire starting on clothing should a cigarette or match be dropped whereas standard materials can be highly flammable. Like fire retardant bedding and fire-retardant throws, fire retardant nightwear is not a fire proof item and does not remove the risk of fire entirely, it only reduces the risk.

f) Gas Cut off Valve - Suitable for people experiencing certain cognitive issues, such as dementia. This device when used in conjunction with a gas leak detector can shut down the supply. Many newer cookers will automatically cut the gas off if the flames are not ignited. However, if the oven or hob do not do this, the valve can be used to lock the gas cooker temporarily.

g) Gas Detector - Suitable for people experiencing certain cognitive issues, such as dementia. A gas detector will sound an alert if natural gas, for instance coming from an un-ignited hob, is detected. It can be used in conjunction with a gas cut off valve to shut down the supply. The most widely used version also includes a carbon monoxide detector for increased safety. It is important to note that these devices are only triggered by dangerous levels of gas, but an unlit hob left on will take some time to reach the point where a gas detector will be triggered.

h) (Specialist) Smoke Alarm - Suitable for people with hearing impairments, this device is designed to activate the flashing light and/or the vibrating pad connected to it, giving

extra vital early warning and extra time to escape in the event of fire. Contact Action on Hearing Loss (formerly RNID) for further information.

i) Smoker's Fire-Retardant Apron - The smoker's apron protects clothing and people from burns and can be an effective fire safety measure for those people with dementia and/or mobility concerns who smoke.

j) Sounder Beacon - The sounder beacon combines a visual warning together with a loud siren to alert people with hearing difficulties to a certain type of alarm activation such as a smoke alarm or an incoming phone call. Different colour versions of the sounder can be fitted in conjunction, allowing the user to differentiate between an alarm and a door entry call.

k) Stovetop / Cooker Shut Off Device - Suitable for people with cognitive impairment. The device uses motion sensing when a person is cooking and automatically begins a countdown to shut off the cooker hob when it senses that the kitchen has been vacated. Similarly, when a person comes back into the kitchen to check on cooking it will automatically reset the countdown. It works on most hobs whether gas or electric. Wired and wireless versions are available.

l) Temperature Monitors - Suitable for vulnerable people who live alone. These are devices that monitor temperature and power cuts in homes. Of particular interest are those devices which have a SIM card inside which is used to send text message alerts, for instance rapid rise in temperature alert (i.e. for a fire) directly to family members/carers. Alerts can also be transmitted as email alerts or phone calls to a monitoring centre for Telecare.

m) Visual Call Beacons - Suitable for people with hearing impairments. It provides a visual warning only in order to alert users to a certain type of alarm activation (e.g. smoke detector) or to an incoming phone call.

n) Wi-Safe Remote Warning Handset - Suitable for older people and/or people with disabilities. It responds to wireless signals from Wi-Safe smoke and/or carbon monoxide alarms. Once activated, these alarms alert the handset to the danger of fire or to the presence of carbon monoxide. The handset will sound and flash giving early warning and a better chance of escape. The removable handset doubles as an escape torch.

o) Water Suppression Systems (sprinkler and watermist) - Suitable for vulnerable individuals at a higher risk of having a fire such as smokers, and those with impaired ability to respond appropriately for example due to physical and/or cognitive issues. Water suppression systems significantly lower the risk of death and serious injury from fire. This is done by helping to suppress a fire at an early stage, preventing it spreading, and minimising the water damage which is associated with traditional methods of fire suppression.

6. References

1. Approved Document B (fire safety) Volume 1 – Dwelling Houses, 2006 edition incorporating 2007, 2010, 2013, November 2018 , December 2018 and April 2019 amendments
2. BS 9991:2015 Fire safety in the design, management and use of residential buildings. Code of practice

3. BS 9999:2017 Code of practice for fire safety in the design, management and use of buildings
4. NFPA 101:2018 Life Safety Codes 2018 Edition
5. Fire Safety in Specialised Housing (2017), National Fire Chiefs Council (NFCC)
6. Practical Fire Safety Guidance for Care Homes (2014), Scottish Government
7. Standish R (2010). Technical Brief no. 5 - Fire Safety in Extra Care Housing in the UK, Housing Learning and Improvement Network
8. Standish R (2016). Fire Safety in Specialised Housing - Extra Care Housing, Housing Learning and Improvement Network
9. London Fire Brigade, Home Fire Safety Risk Referral Matrix
10. Ageing Safely – Protecting an Ageing Population from the Risk of Fire in the Home, Chief Fire Officers Association (CFOA) publications
11. Mobility Scooter Guidance for Residential Buildings (2018), National Fire Chiefs Council (NFCC)
12. Fire Safety Risk Assessment – Residential Care Premises (2006), HM Government
13. Society of Fire Protection Engineers (2019). Population Characteristics. In: SFPE Guide to Human Behavior in Fire. Springer International Publishing, Cham, pp 15-19.
14. Arup Fire, British Automatic Fire Sprinkler Association (BAFSA) (2006). Sprinklers for Safer Living – The Benefits of Automatic Fire Suppression Systems in Residential Care Premises
15. BS 5839-1:2017 Fire detection and fire alarm systems for buildings. Part 1: Code of practice for design, installation, commissioning and maintenance of systems in non-domestic premises
16. PD 7974-7:2019, Application of fire safety engineering principles to the design of buildings – Part 7: Probabilistic risk assessment
17. Home Office National Statistics 2019, Detailed analysis of fires attended by fire and rescue services, England, April 2018 to March 2019
18. Harpur A., Boyce, K., Mcconnell. N. An investigation into the circumstances surrounding elderly dwelling fire fatalities and the barriers to implementing fire safety strategies among this group. Fire Safety Science, 11 (2014). pp. 1144-1159.
19. Fire Safety and the Ageing Population (2016), Arnhem: Instituut Fysieke Veiligheid (IFV).
20. Fire Alarms and At-Risk Populations, Fire Protection Research Foundation 2017
21. Dementia Institute (BUDI) (2015), Fire Safety Innovations for People Affected by Dementia, Report on Focus Group and Survey findings, November 2015
22. Friesinger, J.G., Topor, A., Bøe, T.D. et al. The ambiguous influences of fire safety on people with mental health problems in supported housing. Palgrave Commun 5, 22 (2019). https://doi.org/10.1057/s41599-019-0230-0
23. Folk, Lauren & Gonzales, Kiara & Gales, John & Kinsey, Michael & Carattin, Elisabetta & Young, Tim. (2020). Emergency egress for the elderly in care home fire situations. Fire and Materials. 10.1002/fam.2820
24. CS Development Team (2015), Assisted Living Technology Catalogue. Available at: https://www.london-fire.gov.uk/media/2238/1-assisted-living-technology-catalogue.pdf

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