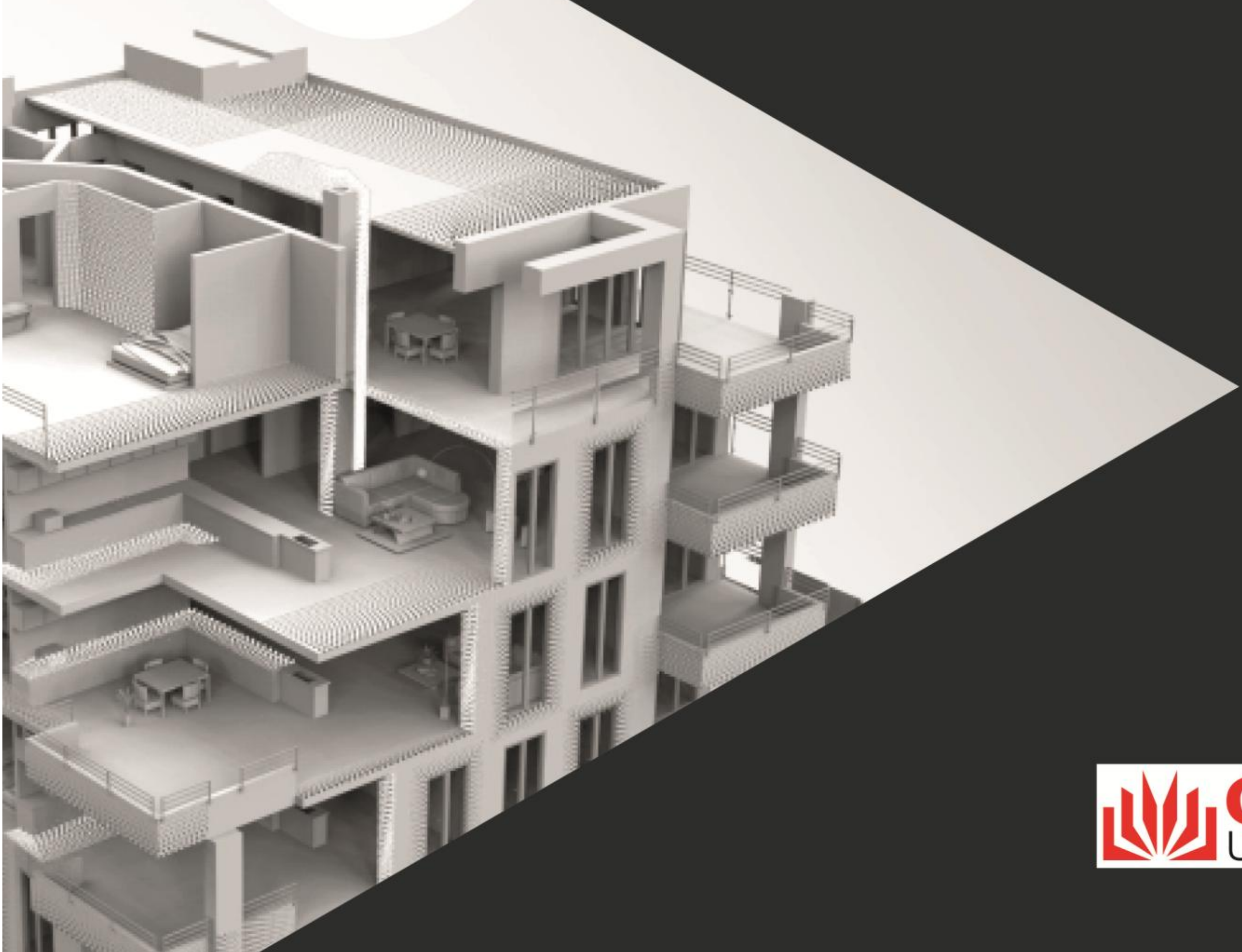
An Examination of Building Defects in Residential Multi-owned Properties

Authored by: Nicole Johnston (Deakin)
with Sacha Reid (Griffith)



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Acknowledgements

The Chief Investigators for this project gratefully acknowledge the research support from Associate Professor Edward Podolski (Deakin University), the technical assistance and passion of Lynda Kypriadakis and research assistance from Jason Cottam, Rebecca Irvine and Nicholas Keel.

The graphic images used in this report and the presentation material associated with this research project, were created by Dr Anastasia Globa.

We would like to thank the members of the Industry Reference Groups (IRG) for their support and valuable contribution to the project:

Members	Position	Organisation Affiliations
Nicole Wilde	Partner (Lawyer)	Tisher Liner FC
Tim Graham	Partner (Lawyer) President	HWL Ebsworth Australian College of Strata Lawyers (ACSL)
Alan Ferre	Regional Manager	CHU Insurance
Hayley Klestadt	Committee Member Engineer	 Nova Systems
Louisa Herbert	Strata Manager	MBCM (Box Hill)
Andrew Redburn	Partner (Lawyer)	Active Lawyers
Jason Carlson	Partner (Lawyer)	Grace Lawyers
Grant Mifsud	Strata Manager	Archers Body Corporate Management
Lindsay Cherry	National Underwriting Manager	CHU Insurance
Bob Hook	Fire Compliance Consultant	FiRiAs

This project was supported by a number of research partners and we are grateful for the valuable contributions made by each of them. We make special mention of Prudential Investment Company of Australia (PICA Group) for its financial contribution.

Buildcheck

Author contact: Nicole Johnston (E: nicole.johnston@deakin.edu.au)

Date of publication: June 2019

Table of contents

List of Tables

List of Figures

1 Introduction and Background

It is reasonable to expect that our home is constructed in a manner that, at the very least, is stable, safe, sheltered and fit for purpose. Unfortunately, new residential buildings in Australia appear to be plagued with defects. Although the building itself can be fractured by these defects, it is the residents living there who face the impacts. These include but are not limited to: risk to life, risk to personal safety, risk to health (physical and psychological), increased financial costs, and in some instances removal from the property. In the multi-owned property environment, those that govern (the owners corporation and its committee) and manage these buildings can be significantly impacted due to the complexities associated with rectifying defects.

Building defects are common phenomena in the construction industry worldwide[1] and have become an "accepted part of the building process".[2] The concern is not that defects occur, they are inevitable. The concern is the extent, severity and impact these defects have on buildings and their occupants.

Therefore, it is essential to gain a better understanding of the nature of defects in residential multi-owned properties in order to respond effectively. As suggested by Sommerville, "…the primary area of [research] focus should be aimed at discovering where, when, how and why defects are occurring so frequently in the construction of new buildings. Once these are discovered and resolved then hopefully, money and time will be saved on both construction and consumers' efforts."[3]

This research project attempts to answer some of the questions Sommerville poses by:

1. identifying the types of defects impacting residential buildings;
2. understanding the impacts defects have on buildings and occupants;
3. assessing the regulatory environment relating to building construction;
4. understanding how defects are managed and rectified within the multi-owned property environment.

The paper is divided into five parts. Part one provides an overview of the relevant academic literature relating to building defects. Part two outlines the study's methodological approach including the methods used (building defect reports analysis, stakeholder and end-user structured interviews and regulatory review). Part three provides the results and findings of the data analysis. Part four discusses these results and provides concluding remarks. The final part of the paper highlights the study's limitations and offers some direction for future research-based on the results and findings of the study.

2 Literature Review

This literature review has a twofold objective; to outline scholarly works that have examined aspects of building defects as they relate to multi-owned properties and in turn, highlight the gaps in knowledge that this research project can begin to narrow. The first part of the review provides the property context and the importance of focusing on multi-owned properties. It then looks at the definition of buildings defects, the types of defects identified in residential buildings (with a specific focus on Australia, Spain and Singapore), the causes of defects, the systems used for classifying the types of defects, the impacts of defects, and the regulatory environment in Australia relating to the construction of residential buildings.

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[1] Nadira Ahzahar et al, 'A Study of Contribution Factors to Building Failures and Defects in Construction Industry' (2011) 20 *Procedia Engineering* 249.

[2] Anthony Mills, Peter Love and Peter Williams, 'Defect costs in residential construction' (2009) 135(1) *Journal of Construction Engineering and Management* 12, 16.

[3] James Sommerville, 'Defects and rework in new build: an analysis of the phenomenon and drivers' (2007) 25(5) *Structural Survey* 391, 402.

2.1 Multi-owned Properties – The Context

The focus of this research is to examine building defects in a particular property context, that being the multi-owned property environment. Multi-owned properties are property schemes that consist of at least two lots tied to common property with a private entity incorporated via registration to govern and manage the scheme.[4] In Australia, these property schemes are referred to as: strata title, community title, subdivisions with owners corporations, unit titles or group titles. Although free-standing dwellings (that are not attached to other properties) can be created under this model, for the purpose of this project, they have been excluded. The focus is directed toward medium and higher density living environments.

Multi-owned properties are the focus of this project for the reasons outlined below:

1. in urban areas of Australia, this property type is becoming the dominant property form (over 2.2 million Australians live in this property type);[5]
2. the original purchases are usually off-the-plan (take it or leave it) sales contracts, so new owners provide little (if any) input into the design and construction;
3. the size, height and complexity of this property type means more people could be at risk or harmed in the event of significant system failures. As noted by Forcada et al. more defects are located in higher density housing as a result of inferior materials, a lack of worker motivation (due to repetitive work) and tighter time schedules forcing workers to rush;[6] and
4. collective action is required to commence legal proceedings against the responsible parties for rectification works to commonly owned property. As a result, it can be more difficult to hold builders and other professionals to account as more statutory hurdles are imposed.

Previous research has suggested the rectification process for multi-owned properties is more difficult due to the associated costs[7] and the common practices undertaken by property developers. Such practices attempt to stifle the ability of owners corporations to seek legal recourse for the rectification of the defects.[8] They do this by: frustrating the decision-making process (by controlling the voting power of a committee), attending to minor defects only (showing that work is progressing while ignoring major defects), and ignoring their statutory duty to hand over construction related documents.[9] As highlighted in the research, the rationale for disrupting the rectification process is to maintain profits, because building rectification is a costly game.[10]

[4] Referred to as: body corporate, owners corporation, association. In this report, the term owners corporation will be used.
[5] Hazel Easthope, Caitlin Buckle and Vandana Mann, 'Australian National Strata Data 2018' (2018). City Futures Research Centre, UNSW Australia.
[6] Nuria Forcada et al, 'Influence of building type on post-handover defects in housing' (2012) 26(4) *Journal of Performance of Constructed Facilities* 433.
[7] Peter Love and David Edwards, 'Calculating total rework costs in Australian Construction Projects' (2005) 22(1) *Civil Engineering and Environmental Systems* 11.
[8] Nicole Johnston, 'An examination of how conflicts of interest detract from developers upholding governance responsibilities in the transition phase of multi-owned developments: a grounded theory approach' (2016) PhD Thesis.
[9] Ibid.
[10] Ibid.

2.2 Defining 'Building Defects'

No universal term for 'building defects' has been applied across the literature. This complicates the evaluation of the previous work done in this area. Therefore, care needs to be taken when evaluating the outcomes or results of existing studies, particularly across jurisdictions. Construction compliance standards differ across the world. Therefore, what constitutes a defect may also differ if the definition applied requires conformity with construction standards. Sommerville notes the "lack of a standard vocabulary ensures the ambiguity surrounding defects and reworks persists."[11] He also suggests the lack of consensus undermines effective research, which in turn impacts upon industry's ability to satisfactorily reduce defects.[12]

The following highlights the range of definitions outlined in the literature:

> "The nonconformity of a component with a standard of specified characteristics."[13] Non-conformance is the term used by the International Organization for Standardization (ISO) 9000:2005 to define the failure to fulfil a requirement.[14]
>
> "A defect is deemed to occur when a component has a shortcoming and no longer fulfils its intended function."[15]
>
> "Any kind of deviation caused by a technical problem that results in misuse of resources or additional cost during construction."[16]
>
> "A fault or imperfection resulting from poor design and/or construction of a building."[17]
>
> "Building defects are building faults that have existed since construction or been triggered later on by faulty original construction or design." [18]

However, it is important to note that efforts have been made to adopt a consistent definition. More recently published works,[19] have referenced a definition outlined by Watt who takes a broader approach and defines a building defect as:

> "a failing or shortcoming in the function, performance, statutory or user requirements of a building, and might manifest itself within the structure, fabric, services or other facilities of the affected building." [20]

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[11] James Sommerville (n 3).
[12] Ibid 402.
[13] David Nicastro and Andrea Surovek, 'Defects, Deterioration, and Durability in Robert T.Ratay (ed), *Structural Condition Assessment* (Wiley, 2005) 1, 3.
[14] International Organization for Standardization, 'Quality Management Principles' https://www.iso.org/files/live/sites/isoorg/files/archive/pdf/en/pub100080.pdf
[15] Jim Georgiou, 'Verification of a building defect classification system for housing' (2010) 28(5) *Structural Survey* 370, 371.
[16] Monika Jingmond and Robert Agren, 'Unravelling causes of defects in construction' (2015) 15(2) *Construction Innovation* 198, 198.
[17] Hazel Easthope, Bill Randolph and Sarah Judd, 'Managing Major Repairs in Residential Strata Developments in New South Wales' (2009) City Futures Research Centre, UNSW 1, 10.
[18] Hazel Easthope, Bill Randolph and Sarah Judd, 'Governing the Compact City: The role and effectiveness of strata management (Final Report)' (2012), City Futures Research Centre, UNSW 1, 65.
[19] Hamad Aljassmi and Sangwon Han, 'Analysis of Causes of Construction Defects Using Faculty Trees and Risk Importance Measures' (2013) 139(7) *Journal of Construction Engineering and Management* 870; Nuria Forcada, et al, 'Assessment of construction defects in residential buildings in Spain' (2014) 42(5) *Building Research and Information* 629; Marcel Macarulla et al, 'Standardizing Housing Defects: Classification, Validation, and Benefits' (2013) 139(8) *Journal of Construction Engineering and Management* 968.

Scholars from the discipline areas of construction, architecture and engineering (more broadly, the built environment) have dominated this area of research. The definitions presented in the literature and the debates that follow illustrate these disciplinary slants. Therefore, it is not surprising little attention has been paid to the legal definition of a 'building defect' in the literature. What constitutes a building defect and how it is legally defined becomes important for those wishing to commence proceedings against a responsible party. Unfortunately, the inclusion of a legal definition in this research area only adds to the inconsistency relating to the overall definition of building defect. Legal definitions are rarely consistent across jurisdictions (both globally and nationally) and are often drafted in a manner that requires interpretation by experts. The definition applied in any given study may therefore be dictated by the purpose and aims of any given research project.

2.3 Types of Building Defects

Evaluating the types or nature of building defects reported in the literature is also a challenging task. The challenge arises due to the inconsistent use of the term 'building defects', the types of residential building products evaluated (e.g. free standing dwelling, apartment, townhouse), data source variations (e.g. compliant forms, observations, end-user surveys) and the different stages of construction in which the defects arise or were reported. As Forcada et al observed, "defects detected in each stage of a building's lifecycle (construction, handover, post-handover, and maintenance) are different, just as the perception of quality and what constitutes defective work varies between client, the developer and the contractor". [21]

Contributing to these challenges is the paucity of research that has focused on identifying the types of building defects present in new buildings (particularly residential multi-owned properties). Studies undertaken in Spain, Australia and Singapore offer insights into the most prevalent building defects identified in residential multi-owned properties.

2.3.1 Spain

Forcada et al have undertaken a number of studies in Spain examining the nature of building defects in both newly constructed private houses and residential buildings.

In 2012, the authors reviewed complaint forms and categorised defects based on building type (detached v attached).[22] The sample was taken from seven building developments containing 533 dwellings. A total of 2, 351 defects were identified and analysed.[23] The core elements impacted by defects in residential buildings (flats) were noted as: item (18%) (i.e. missing item), internal wall (15%), floor (12%), door (11%) and window (11%).[24] In detached houses, the defects reported related to: doors, windows, item and internal walls.[25] The authors noted most of the defects were omissions or technical defects. Interestingly, the authors tested the relationship between building characteristics and the identified defects. They found the number of defects was significantly associated with construction costs, the number of dwellings in a development, the number of floors in the building and the distance the construction site was from the contractor's headquarters.[26]

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[20] David Watt, *Building pathology: principles and practice* (Blackwell Publishing, 2nd ed, 2007) 96.
[21] Nuria Forcada et al (n 6) 437.
[22] Ibid.
[23] Ibid.
[24] Ibid.
[25] Ibid.
[26] Ibid.

In 2014, the authors conducted a study specifically focused on the construction stage of a building. They derived their data from non-conformance forms obtained by two large builders' databases.[27] The sample included 68 buildings and 3676 construction-based defects were identified for analysis. Using Watt's definition of a building defect, the author found: 73% of defects were located in 'general' and exterior areas and floors above ground; pillars (14%), internal walls (12%), external walls (11%) and water related defects (4%).[28]

2.3.2 Australia

In Australia, two studies have been undertaken which, in part, focus on identifying the most common building defects in residential multi-owned properties. The studies were both conducted by the same group of researchers (Easthope, Randolph and Judd). The first study conducted in 2009 sought to identify the most common defects as identified by lot owners (Study 1, n = 93).[29] Water ingress, internal and external wall cracking, roofing and guttering problems and tiling faults were identified as the most common building defects. Other defects identified related to electrical faults, windows and doors, façade and balcony construction. In 2012, anchored off the original study, the researchers surveyed a larger owner cohort (Study 2, n = 1011).[30] Similarly, respondents identified water leaks (42%), internal and external wall cracking (42%), exterior water penetration (40%), guttering problems (25%), defective roof coverings (23%), plumbing faults (22%), and tiling related defects (20%).[31]

2.3.3 Singapore

Studies undertaken on residential buildings in Singapore focus primarily on defects related to water-tightness. In a 2002 study, authors Chew and De Silva found the most prevalent defects in residential multi-owned properties related to water leakages (that is, 36% of all defects).[32] The authors reported that 50% of buildings, within the first year post-construction, had internal water leakage problems. The water leakage related defects were located around pipe penetrations (the most prevalent), construction joints, internal walls and slabs.[33] More specifically, the water penetrations related to the waterproof membranes.[34] These defects were identified using field surveys and defect audit reports (n = 120 buildings).[35]

In 2005, a study by Chew, interviewed property managers and undertook site surveys of non-residential buildings (n = 56 commercial buildings) and found 53% of defects related to water ingress, followed by pipe corrosion (50%) and concrete spalling (47%).[36]

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[27] Nuria Forcada, et al, 'Assessment of construction defects in residential buildings in Spain' (2014) 42(5) *Building Research and Information* 629

[28] Ibid.

[29] Hazel Easthope, Bill Randolph and Sarah Judd (n 17) 10.

[30] Ibid.

[31] Hazel Easthope, Bill Randolph and Sarah Judd (n 18) 1.

[32] MYL Chew and Nayanthara De Silva, 'Factors affecting water-tightness in wet area of high-rise residential buildings' (2002) 45(4) *Architectural Science Review* 375.

[33] Ibid.

[34] Ibid.

[35] Ibid.

[36] MYL Chew, 'Defect analysis in wet areas of buildings' (2004) 19 *Construction and Building Materials* 165.

2.4 Causes of Building Defects

Attempts have been made by researchers to identify the stages (in development) in which defects arise. Studies have shown 50 to 60% of building defects are attributed to design issues[37] or would have been preventable with better design.[38] Therefore, 40 to 50% of defects arise in the construction phase. Josephson and Hammarlund examined defect costs and found 32% originated in the earlier phases of development (including design), approximately 45% originated on site and approximately 20% related to materials and machines.[39] These authors do caution extrapolation of these results. Focusing specifically on wet areas, Chew found the majority of defects related to construction practices.[40]

2.4.1 Human Errors and Endogenous Factors

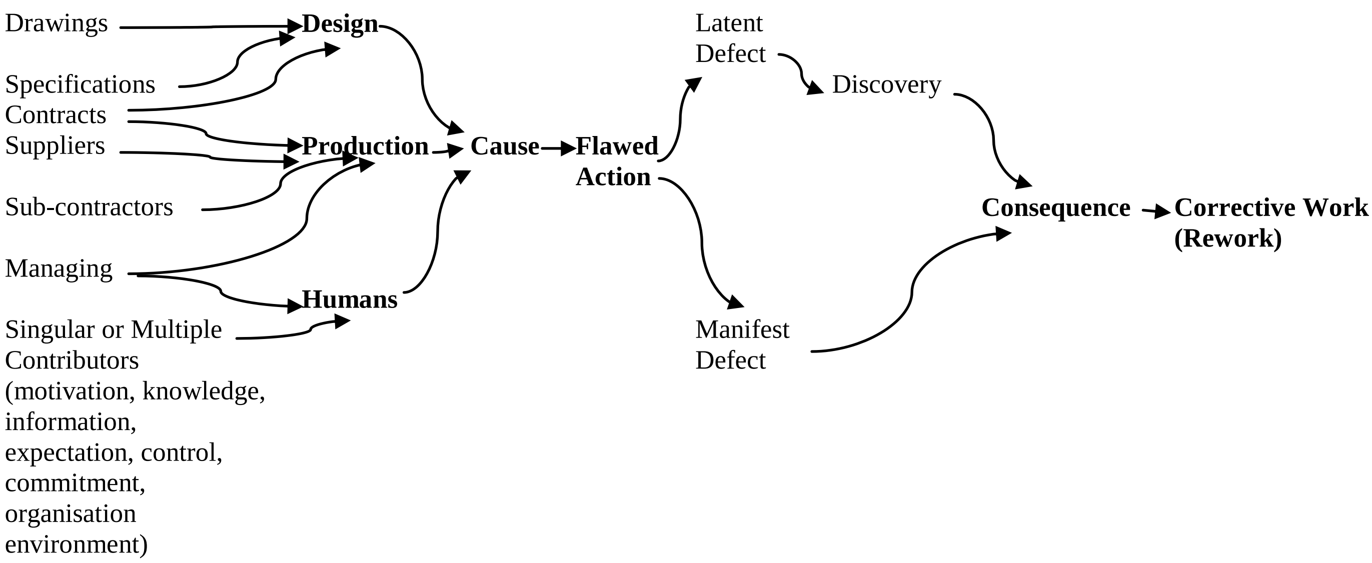
While much of the literature highlights human error as the immediate cause of building defects, specifically: poor workmanship / incompetence, poor supervision, lack of skills, knowledge and experience, lack of motivation (leading to forgetfulness or carelessness),[41] the originating causes have been attributed to organisational practices. For Jingmond and Agren, "endogenous organisational factors have been identified as the main cause of defects."[42] Such factors include: instability in the client organisation (key people often change), client's project control (day to day plans often change), late visits to site and people changing their minds, time pressure, composition of the project organisation (those who had worked together before did better), cost pressure (lowest bid wins strategy), support to the site organisation (lack of support), and motivation (lack of activities aimed at motivating).[43] Drane further suggests there is a higher likelihood for defects when the building design is developer led (as opposed to client / architect led), the developer and builder are inexperienced, the building delivery system is design and construct, there is an absence of project management, there is a private certifier (as opposed to a council certifier), and detail design is left to subcontractors (as opposed to architects).[44] As a result, some researchers suggest that, "to reduce the incidence of defects, effort is needed to change procedures in project management, as these are more likely to have greater impact than either further training or changes in routines on the construction site." [45]

[37] James Sommerville (n 3); Wai-Kiong Chong and Sui-Pheng Low, 'Latent Building Defects: Causes and Design Strategies to Prevent Them' (2006) 20(3) *Journal of Performance of Constructed Facilities* 213.
[38] Wai-Kiong Chong and Sui-Pheng Low, 'Latent Building Defects: Causes and Design Strategies to Prevent Them' (2006) 20(3) *Journal of Performance of Constructed Facilities* 213.
[39] Per-Erik Josephson and Y Hammarlund, 'The causes and costs of defects in construction: A Study of seven building projects' (1999) 8 *Automation in Construction* 681.
[40] MYL Chew (n 34).
[41] Nuria Forcada et al (n 6); Nuria Forcada, Marcel Macarulla and Peter Love, 'Assessment of Residential Defects at Post-Handover' (2013) 139(4) *Journal of Construction Engineering and Management,* 372; Jim Georgiou, Peter Love and J Smith, 'A comparison of defects in houses constructed by owners and registered builders in the Australian State of Victoria' (1999) 17(3) *Structural Survey* 160; Peter Love, Peter Davis and Denis Worrall, 'Occupational licensing of building trades' (2010) 136(4) *Journal of Professional Issues in Engineering Education* 215; Anthony Mills, Peter Love and Peter Williams, 'Defect costs in residential construction' (2009) 135(1) *Journal of Construction Engineering and Management* 12; Wai-Kiong Chong and Sui-Pheng Low, 'Latent Building Defects: Causes and Design Strategies to Prevent Them' (2006) 20(3) *Journal of Performance of Constructed Facilities* 213.
[42] Monika Jingmond and Robert Agren (n 16) 214.
[43] Per-Erik Josephson and Y Hammarlund (n 37).
[44] Jonathan Drane, 'Building Defects: How can they be avoided? – a builder's perspective', paper presented at the Strata and Community Title in Australia for the 21st Century 2015 Conference, Gold Coast, Australia.
[45] Monika Jingmond and Robert Agren (n 16) 214.

2.4.2 Interrelated Causes

Although more attention has been paid to these human-based errors and endogenous factors, many authors have observed there are often "multiple interrelated causes that combine to form a defect's pathway".[46] Explaining the complex nature of building defects, Aljassmi et al suggests the problem with: "[m]erely identifying root causes is that it lacks a thorough understanding of the mechanics and complex correlations acting among causes, making the strategy less explanatory; furthermore, comprehending these root causes is not always guaranteed because their association with the up-front incidence is not easily visualised."[47] Figure 1, highlights Sommerville's model of multiplex rework (or rectification) pathway.[48] Missing from this model (and much of the literature) are exogenous factors that maybe a causal factor or at least, a contributor. Such factors could include building related regulations, codes and standards.

Figure 1: Sommerville's model of multiplex rework pathway



2.5 Classifying Building Defects

Taking into consideration that different definitions of building defects have been applied in various research studies, a building defect can range from a mere imperfection (for example, a chipped tile or mark on a wall) to a structural fault that could create instability in a building. It is important to classify defects in order to gain a better understanding of their impact. Furthermore, the classification of a defect becomes important for parties wishing to commence proceedings against a builder or other party. Statutory time limitations (to commence proceedings) are often imposed based on the nature of the defect and how it is classified. Defects classified as major or structural (under the relevant legislation) usually have a longer time limitation period (for example, six to 10 years). This extended period is provided because some defects do not manifest for several years post-construction.

In Australia, the legislation in each jurisdiction prescribes the parameters of what conditions need to be satisfied to classify a defect as a major or structural defect. For Porteous, a major defect is defined as one that "renders the building unsafe, uninhabitable, or unusable for the purposes for which the

[46] Hamad Aljassmi and Sangwon Han, 'Analysis of Causes of Construction Defects Using Faculty Trees and Risk Importance Measures', (2013) 139(7) *Journal of Construction Engineering and Management* 870, 870.
[47] Ibid 871.
[48] James Sommerville (n 3).

building was designed or intended."[49] Georgiou, Love and Smith agree with the minor / major classification model but suggest taking into account the severity of the defect and whether the defect relates to a technical, aesthetic and functional aspect.[50] Technical defects are present when the workmanship or materials used to produce an element reduce its capacity to fulfil the functional performance of the structure. Aesthetic defects are evident when the appearance of the building element or material is undesirably affected. Functional defects are present when the building fails to function in its intended manner.[51]

Efforts have been made to develop more detailed defect classification systems, but the focus has not been multi-owned properties specifically. Georgiou[52] and Macarulla et al[53] developed defect classification systems specifically for the housing sector. Georgiou's classification system consists of 35 building elements and 12 defect types (including cracking, damp, drainage, external leaks, incomplete, internal leaks, miscellaneous, regulations, structure adequacy, water hammer, window sill gap, and workmanship).[54] Macarulla et al identified different approaches to classifying housing defects – by severity, by construction stage, by type and by cause.[55] Fifteen categories were developed including: affected functionality, inappropriate installation, biological action and change, broken/deteriorated, chemical action and change, detachment, soiled, flatness and levelness, misaligned, missing, stability/movement, surface appearance, water problems, tolerance errors, others. The categories developed by these authors appear to include both defects and the causes of the defects.

Chong and Low[56] on the other hand, developed a systematised classification system, segregating building defects based on seven main categories including: location, materials, defect description, failure mechanisms, elements, design parameters and roots. These categories were then divided into sub-groups. For example, under the category of elements, 11 further sub-categories were created (floor, external wall, internal wall, doors, windows, mechanical and electrical systems, plumbing and sanitary system, and roofs).[57] In their study on latent building defects in Singapore, the authors reviewed the defects in a variety of buildings including hospitals, residential, commercial and other institutional buildings (n = 35).

Although these developed classification systems contribute to the literature, missing is a comprehensive and systematised classification system for understanding the nature of defects in the multi-owned property context.

2.6 Severity and Impact of Building Defects

Research on the severity or impact of building defects has received little attention. Defects are often classified as major or minor. This differentiates the severity and therefore potential impact of the defect. Research is limited in terms of assessing risk (to life, health and the building). However, there has been research conducted on the health effects of dampness and mould in buildings and the quality of housing on health. Building dampness and mould have been positively associated with a number of

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49 William Porteous, 'Identification, evaluation and classification of building failures' (1992), PhD Thesis, Victoria University of Wellington, Wellington, New Zealand.

50 Jim Georgiou, Peter Love and J Smith, 'A comparison of defects in houses constructed by owners and registered builders in the Australian State of Victoria' (1999) 17(3) *Structural Survey* 160.

51 Ibid.

52 Jim Georgiou (n 15).

53 Marcel Macarulla et al, 'Standardizing Housing Defects: Classification, Validation, and Benefits' (2013) 139(8) *Journal of Construction Engineering and Management* 968.

54 Jim Georgiou, Peter Love and J Smith (n 48).

55 Marcel Macarulla et al (n 51).

56 Wai-Kiong Chong and Sui-Pheng Low, 'Latent Building Defects: Causes and Design Strategies to Prevent Them' (2006) 20(3) *Journal of Performance of Constructed Facilities* 213.

57 Ibid.

respiratory and asthma related health problems in a number of research studies.[58] Housing quality has also been positively correlated with psychological wellbeing. That is, factors that reduce housing quality such as: structural deficiencies, cockroach and rodent infestation and, dampness and mould adversely affect people's psychological health.[59] The literature is lacking in research focused on understanding the health risks associated with various building defects and the psychological and financial impacts for occupants (owners, investors and tenants) and committees managing the rectification process.

2.7 Regulatory Environment

Understanding the regulatory environment is critical when evaluating building defects across jurisdictions. Context is important due to the level of prescription or flexibility afforded in the rules and regulations and the variances in compliance standards. Some jurisdictions take a very prescriptive approach offering specified methodologies in relation to construction practices, while others allow alternative solutions to be incorporated into building construction. Furthermore, the purpose or objectives of the regulations must also be taken into account when comparing jurisdictions. This is because the purpose / objectives provides the lens in which the underlying provisions or requirements are set.

Although the relevant building regulations in Australia do not align perfectly, there are common purposes outlined. The purposes for most States revolve around regulating:

- building work;
- accrediting building products; and
- registrations or licensing requirements for building practitioners.[60]

The main objectives focus on promoting the proper construction of buildings and ensuring the health and safety of people using buildings.[61]

In Australia, it is the National Construction Code (NCC) (a performance-based regulatory system) that provides the standards in which all buildings must comply. The next section of this paper provides a brief overview of the NCC and the literature relating to performance-based regulatory systems and considered alternatives.

2.7.1 The National Construction Code (NCC)

The purpose of the NCC is to set technical design and construction provisions for all types of buildings. The NCC is a performance-based code setting minimum standards to ensure buildings are constructed in a safe, accessible and sustainable manner.[62] In order for the NCC to have legal effect, each State and Territory either adopts the NCC or requires compliance of the NCC through building and plumbing Acts or regulations. It remains the domain of the States and Territories to override, amend or delete any provision of the NCC. The NCC's primary users are professionals involved in the construction of buildings (including architects, builders, plumbers, engineers, certifiers / surveyors and trades).[63]

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[58] W J Fisk, Q Lei-Gomez and M. J. Mendell, 'Meta- analyses of the association of respiratory health effects with dampness and mold in homes' Indoor Air (2007) 17 284.
[59] Gary Evans, Nancy Wells and Annie Moch, 'Housing and Mental Health: A Review of the Evidence and a Methodological and Conceptual Critique' (2003) *Journal of Social Issues* 59(3) 475.
[60] See for example: Building Act 1993 (Vic), Building Act 1975 (Qld) and Queensland Building and Construction Commission Act 1991 (Qld).
[61] See for example: Building Act 1993 (Vic) and Environmental Planning and Assessment Act 1979 (NSW).
[62] Australian Building Codes Board, *National Construction Code* 2019 (Volumes 1 and 3).
[63] Ibid

In order to comply with the NCC, a party must comply with the Governing Requirements (that is, rules and instructions for compliance) and the Performance Requirements set out in the NCC. Performance Requirements are satisfied if one or a combination of the stated solutions (performance solutions or deemed-to-satisfy solutions) is complied with.[64] A performance solution can be achieved in two ways – (1) complying with all relevant performance requirements or, (2) the solution is at least equal to the deemed-to-satisfy provisions. A number of assessment methods are detailed in the NCC, which can be used to verify the performance requirements have been complied with. Performance solutions allow more flexibility, allowing engineers and builders to develop the solution. A deemed-to-satisfy solution is prescriptive, as it has been deemed to meet the Performance Requirements.

The NCC is limited to the extent that it does not contain details of every design and construction requirement for a construction system[65] nor does it provide deemed-to-satisfy solutions for every design and construction element. In order to provide additional guidance, the NCC relies on additional reference documents, which include Australian Standards, Australian Building Code Board (ABCB) protocols, ABCB standards and other publications. These reference documents are applied only to the extent they are not inconsistent with the Performance Requirements of the NCC. Schedule 4 of the NCC lists the referenced documents, the date of creation, the title and the volume of the NCC that applies. Upon review of the schedule the Australian Standards are the predominantly referenced documents. The organisation tasked with the development of the Australian Standards is Standards Australia, a non-governmental, not-for profit organisation.[66] It is the NCC that mandates compliance with the standards. Although Standards Australia develops the standards, it does not disseminate these standards to industry. Under a licence, Standards Australia branded standards can be purchased (at varying costs) through SAI Global.

2.7.2 Performance-based Codes

As highlighted by Meacham, "building regulations are legal instruments intended to ensure that buildings, when constructed in accordance with the regulations, provide socially acceptable levels of health, safety, welfare and amenity for building occupants and for the community in which the building is located."[67] Although traditionally, building regulations like most regulations were prescriptively created, there has been a movement in the past 25 to 30 years toward a performance-based regulatory model. Performance-based regulations have been heralded as the better approach for building regulations because they can better accommodate technological change and international trade of products, provide flexibility, optimise construction costs, and rely less on bureaucratic processes and more on professional accountability.[68] They achieve these outcomes by setting performance goals but providing a level of flexibility in terms of achieving these goals. Most performance-based regulations vary depending on the regulatory area and jurisdiction. However, most incorporate some common elements, which are based on the Nordic Five Level System. That is, the regulatory framework provides some or all of the following: a regulatory goal, functional requirements, performance requirements, verification, and examples of accepted solutions.[69]

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[64] Ibid

[65] Ibid

[66] See: https://www.standards.org.au/about/what-we-do

[67] Brian Meacham et al, 'Performance-based building regulation: current situation and future needs' (2005) 33(2) *Building Research & Information* 91, 91.

[68] Cary Coglianese, Jennifer Nash and Todd Olmstead, 'Performance-based Regulation: Prospects and Limitations in Health, Safety, and Environmental Protection' (2003) 55 *Administrative Law Review* 705; Peter May, 'Regulatory regimes and accountability' (2007) 1 *Regulation and Governance* 8; Greg Foliente, 'Developments in Performance-Based Building Codes and Standards' (2000) 50(7/8) *Forest Products Journal* 12.

[69] Greg Foliente, 'Developments in Performance-Based Building Codes and Standards' (2000) 50(7/8) *Forest Products Journal* 12.

There has been a dearth of research aimed at investigating the effectiveness of performance-based codes generally. However, the leaky building crisis that gripped New Zealand in the 1990s and early 2000s has provided researchers with a case study to explore the weaknesses in this regulatory system as it relates to building defects. May suggests inadequate regulatory accountability was a problem in the New Zealand system.[70] More specifically, he was of the opinion that: the stated goals were imprecisely drafted leading to interpretation issues; there was inadequate regulatory oversight (lax review of alternative products and overreliance on poorly trained building inspectors); and licensing was lacking.[71]

Coglianese suggests in order to overcome the weaknesses in performance-based systems use of hybrid versions that blend instruments, including more prescriptive regulations, may be warranted.[72] Barbaro and Marfella also see value in a different regulatory approach but they submit the NCC incorporates both prescriptive and flexible elements already. Although true, a discretion is provided for many of the performance requirements allowing users to determine the method most suitable for the construction.[73] In any event, these authors reject the constant patchworking to the existing building regulation frameworks, instead favouring a new national two-tiered system.[74] With a specific focus on high-rise construction, Barbaro and Marfella argue what is needed is a solution that considers variations in the different classes of buildings. That is, the complex nature of some building forms requires a slightly different approach. They suggest that: "[a]t its simplest, unless tied to compliance with the deemed-to-satisfy rules, the adoption of "system-based" regulation would require the existence, and the enforcement, of a regime of safety and quality procedures and inspections that is superior to the norm and to be carried out by independent parties and according to a common standard of verification and control that is clearly regulated, and not left at the discretion of those who should check."[75]

2.8 Conclusion

The literature review has exposed the different types of research approaches used in examining building defects. Although efforts have been made to adopt a definition of building defects, the manner in which defects are classified, the type of data used to analyse defects and the methods of enquiry all vary substantially. In turn, there is a lack of consistency in the research findings. This is a complex phenomenon requiring more attention to truly understand the nature of building defects.

3 Methodology

Due to the lack of research undertaken in this area, this research project is a pilot study aimed at evaluating the time required to examine this phenomenon, the costs associated with collecting and analysing the data, and the availability and quality of the data. Therefore, this study is exploratory in nature with an aim to improve the study design for full-scale implementation. The methods of inquiry chosen are based on the availability of data and funding. This section of the report provides an overview of the research methodology including: input from industry representatives, the ethics approvals, and the research methods used.

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[70] Peter May, 'Regulatory regimes and accountability' (2007) 1 *Regulation and Governance* 8.
[71] Peter May, 'Performance-Based Regulation and Regulatory Regimes: The Saga of Leaky Buildings' (2003) 25(4) *Law and Policy* 381; Peter May (n 68).
[72] Cary Coglianese, Jennifer Nash and Todd Olmstead, 'Performance-based Regulation: Prospects and Limitations in Health, Safety, and Environmental Protection' (2003) 55 *Administrative Law Review* 705
[73] Jeanette Barbaro and Giorgio Marfella, 'Back to the Past – Future Challenges for Better, Safer, Building Design and Construction' (2019) 34 *Building and Construction Law Journal* 362.
[74] Ibid.
[75] Ibid 376.

3.1 Industry Reference Groups (IRG)

As part of the research strategy, Industry Reference Groups (IRG) were convened in the early stages of the research project. The purpose of the IRG was to ensure relevant industries had an opportunity to participate in aspects of the research project including the project design and direction. In the first instance, the research team was seeking group feedback, advice and a general discussion around the research proposal including the project's aims, methodologies, outputs and potential funding opportunities.

Following the IRG meetings, it was decided to narrow the focus of the pilot phase to building defects arising in the statutory liability period. Further funding would then be sought to expand the study to include maintenance and repair issues arising after the statutory liability period had ended. The research team and IRG members agreed that focusing attention on building defects within this period was the best utilisation of the time and funding available.

The key outcomes from the IRG meetings included:

- Narrowing the scope of the research project to concentrate in the first instance on building defects (arising in statutory liability period) – taking a lifecycle approach to the research project;
- Focusing on the nature of defects and then governance and management aspects (including accountability and the chain of responsibility);
- Ensuring a good cross-section of residential buildings in the data;
- Reviewing the role of building certifiers / surveyors;
- Including people from the building industry in the interview phase (developers, construction companies and committees);
- Focusing on the role of managers – internal processes and procedures to deal with defects, engagement of auditors, when and why auditors are engaged, referral processes. Concerns raised for new managers in the marketplace;
- Understanding and including the role of insurance;
- Identifying future opportunities: undertaking risk assessments – that is, once defects are identified, analysing the rectification costs and also the gravity of risks and harm to people and property.

3.2 Ethics approval

Due to the nature of the research project, ethics approval was sought and granted by both Deakin University and Griffith University. On 1 February 2018, Deakin University's, Business and Law Faculty Human Ethics Advisory Group approved the project (BL-EC 69-17). Subsequently, the Griffith University Human Research Ethics Committee approved the project (GU Ref No: 2018 / 128).

3.3 Research Methods

Three methods of inquiry have been utilised in this pilot project: building defect audit reports (undertaken in New South Wales, Queensland and Victoria), stakeholder and end-user interviews and a review of the relevant NCC provisions. These methods allowed the research team to investigate the types of defects being reported, the reasons why defects are so prominent in this area, and the impacts they have on buildings and the people living in and managing these schemes.

3.3.1 Method 1: Defect Reports Analysis

The first method used an analysis of building defect audit reports provided by several building consultant / auditing companies (Table 1). Criteria were provided to each company to assist in the collation of the reports. The reports provided were restricted to residential (including mixed-use schemes with a primary residential component) buildings and the audits had to be undertaken within the prescribed statutory limitation period in each of the jurisdictions. No further sampling restrictions were provided.

Table 1: Data Supplier Information

	Reports Provided	Jurisdiction	Type of Report / Data	Construction Dates
Data Provider 1	99	New South Wales	Defect Reports – Engineering & Building Consultants	2003 - 2018
Data Provider 2	47	Victoria	Defect Reports – Engineering & Building Consultants	2008 - 2017
Data Provider 3	66	Queensland	Defect Reports – Building Consultants	2008 - 2017

A preliminary review of the reports was undertaken to determine the extent of variability in the reporting of defects. Although each company had a template for the reports produced, there was variation in relation to the level of detail and the terms or language used to describe the observed defects. The personnel undertaking the audits also varied in terms of background. Some companies engaged engineers, others engaged qualified builders or a combination of both to carry out the audits. It was also difficult to determine the criteria applied in reporting the defect. Some companies may focus less on minor faults or faults that have arisen post-construction.

As a result of the initial review, a building defects matrix was developed by the research team. As suggested by Georgiou[76] and Macarulla[77] information regarding building defects must be organised in a standardised way in order to analyse the data and form conclusions. Due to the non-standardised nature of the reports provided by the building audit companies, it was necessary to develop a defects matrix that allowed for the information provided in the various reports to be extracted, evaluated and compiled in a way to ensure consistency. After a preliminary review of the defect reports, it was determined the reported defects could be classified based on the construction systems relevant to multi-owned properties. The first step in formulating the matrix was to identify the key constructions systems relevant to multi-owned properties (particularly attached properties). These core construction systems are outlined in Table 2.

[76] Jim Georgiou (n 15).
[77] Marcel Macarulla et al (n 51).

Table 2: Core Construction Systems[78]

- Access and Egress
- Building Fabric and Cladding
- Electrical, Lighting and Data
- Fire Protection
- Hydraulics
- In Motion Equipment
- Mechanical and Ventilation
- Roof and Rainwater Disposal
- Safety
- Structural
- Utility Supply
- Waterproofing
- Non-essential Services

The information reported also allowed for the inclusion (in the matrix) of categories that identified both the location of the defect within the scheme and the consequences of and contributors to the defect. The defects, as reported, were then individually entered into the matrix based on the relevant construction system. After the defects were entered, a secondary review was undertaken and the defects were further categorised.[79] The secondary categories are outlined in the results section of this paper. The re-categorisation process allowed for the data to be analysed more efficiently.

3.3.2 Method 2: Stakeholder and End-user Interviews

The second method used was structured stakeholder and end-user interviews. The purpose of the interviews was to gain a deeper understanding of defect prevalence, the causes of defects and the governance and management practices employed by owners corporations dealing with building defects.

Interviews were conducted in New South Wales, Queensland and Victoria. An interview guide was prepared and questions were developed based on the review of the literature and input from the IRG participants. Twenty-one interviews were conducted over a four-month period. Table 3, outlines details of the interviewees.

Table 3: Stakeholder and End-user Interviewees

Reference ID	Stakeholder Background	State	Reference ID	Stakeholder Background	State
1	Committee Member	Qld	12	Developer	Qld
2	Lawyer	NSW	13	Manager	NSW
3	Lawyer	Qld	14	Building Consultant	NSW
4	Lawyer	Qld	15	Manager	Qld
5	Lawyer	NSW	16	Private Certifier	Qld
6	Fire Engineer	Qld	17	Committee Member	NSW
7	Committee Member	NSW	18	Committee Member	Vic
8	Building Consultant	NSW	19	Lawyer	NSW
9	Committee Member	NSW	20	Manager	Vic
10	Committee Member	Qld	21	Lawyer	Vic
11	Manager	Qld			

[78] Australian Building Management Accreditation (ABMA), *ABMA Building Management Code* (2018) Queensland Edition.
[79] These sub-categories were formulated by Lynda Kypriadakis and Nicole Johnston.

All interviews were transcribed verbatim and Nvivo software was used to assist in the interpretation of the interview data. Thematic nodes were created based on the review of the literature and the guidance notes prepared for the interviews. The chief investigators for the research project, jointly, created the thematic nodes and one of the chief investigators coded the interview data. The coded data was independently reviewed then interpreted using thematic analysis.

3.3.3 Method 3: Regulatory Review

The third method reviewed the relevant regulations and codes pertinent to the results and findings of this study. The review provides an overview of the most relevant regulations (for example, building and strata related regulations) and codes (specifically, the NCC) relating to building construction. Although it is acknowledged that many regulations impact upon the construction of multi-owned properties, this review is intended to highlight the core regulations and code. The regulations and code provisions reviewed are scattered throughout the results and findings section of this report. The purpose of which is to align the study results to the regulatory environment. Table 4, provides an overview of the relevant regulations and codes reviewed for this project. The Acts and regulations in bold in Table 4 either adopt the NCC (Vic) or require compliance with the NCC (NSW, Qld).

Table 4: Regulations and Codes Reviewed[80]

Commonwealth	New South Wales	Queensland	Victoria
National Construction Code (Volumes 1 & 3)	Environmental Planning and Assessment Act 1979	**Building Act 1975**	Building Act 1993
	Environmental Planning and Assessment Regulation 2000	Building Regulation 2006 Queensland Development Code	**Building Regulations 2018**
	Home Building Act 1989	Queensland Building and Construction Commission Act 1991	Domestic Building Contracts Act 1995
	Gas Supply Act 1996 Gas and Electricity (Consumer Safety) Act 1997 Work Health and Safety Regulation 2017 Plumbing and Drainage Act 2011	Building Fire Safety Regulation 2008 Plumbing and Drainage Act 2002 Plumbing and Drainage Act 2018	Electricity Safety Act 1998 Gas Safety Act 1997 Occupational Health and Safety Act 2004
	Building and Development Certifiers Act 2018		
	Strata Scheme Development Act 2015 Strata Scheme Management Act 2015	Body Corporate and Community Management Act 1997 & associated regulations	Owners Corporation Act 2006

4 Results and Findings

This section of the report provides the results from the analysis of the building audit reports, interview findings and the review of the relevant regulatory provisions including the relevant sections of the NCC. The first part of the results and findings section provides some building level data, followed by an analysis of the identified defects – both across all constructions systems and then by each construction system. Under each of the 13 construction systems, a table is provided detailing examples of the reported defects and the sub-categories created to collate the data. Descriptive statistics highlight the number of defects relevant to each sub-category. The most prevalent affected construction systems also identify the consequences of and contributors to the defects. The second part of this section highlights the interview findings.

[80] Note: this is not an exhaustive list of all regulations and codes relating to building work or multi-owned properties.

4.1 Building Audit Reports

Across the jurisdictions of New South Wales, Queensland and Victoria, 212 building audit reports consisting of 3227 (line item) defects were analysed. Although all the reports itemised the observed defects, many of the reports collated multiple entries into the one line item without providing an exact count. That is, if the same defect was found across multiple locations within the audited building, it was reported as one line item and the language used was pluralised (for example, missing fire collars). As highlighted in Table 5, 85% of all the buildings analysed had at least one defect across multiple locations. The result was slightly higher in New South Wales (97%) and slightly lower in Queensland (71%) and Victoria (74%). Therefore, although 3227 defects have been analysed across 212 buildings, the number of defects identified by the auditing companies was much higher. The average number of line item defects identified per building was 14, again with a slightly higher result in New South Wales (16) and slightly lower result in Queensland (12) and Victoria (11). The average number of construction systems (noting that 13 construction systems formed the classification matrix) affected by defects per building was 5.93 with a slight variation between the states (NSW = 6.5, Queensland = 5.8 and Victoria = 4.85).

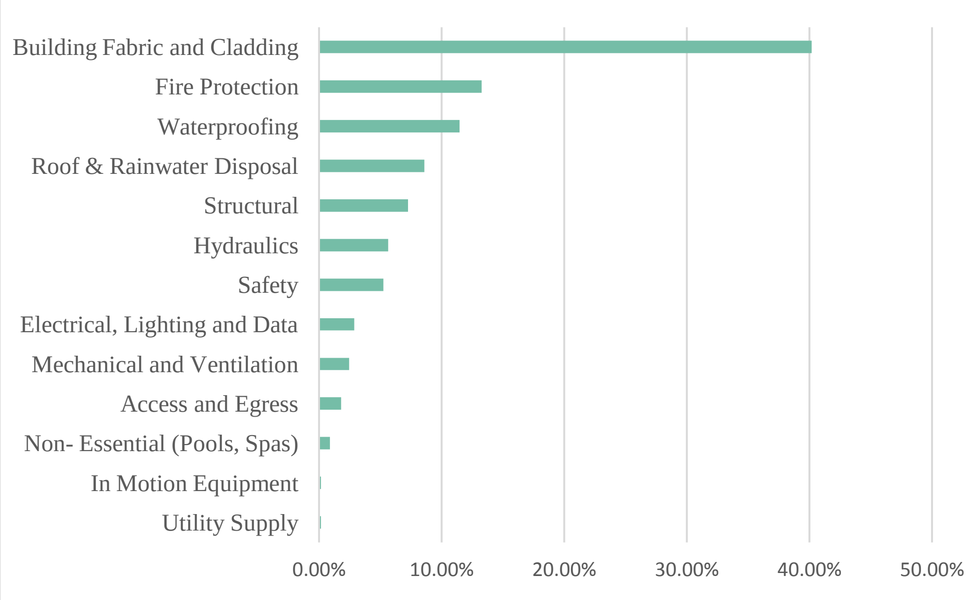
Table 5: Building Level Results across Jurisdictions – Construction Systems Effected, Identified Defects and Multiple locations

		All States	New South Wales	Queensland	Victoria
Average number of construction systems effected	Mean	5.937888	6.518072	5.794872	4.846154
	Std Dev	2.476614	2.480959	2.637578	1.899286
Average number of defects identified	Mean	14.43478	16.74699	12.28205	11.66667
	Std Dev	8.164544	8.057482	8.846494	6.165837
Percentage (%) of buildings with at least one defect across multiple locations	Mean	0.857143	0.975904	0.717949	0.74359
	Std Dev	0.351019	0.154281	0.455881	0.442359

4.1.1 All Construction Systems

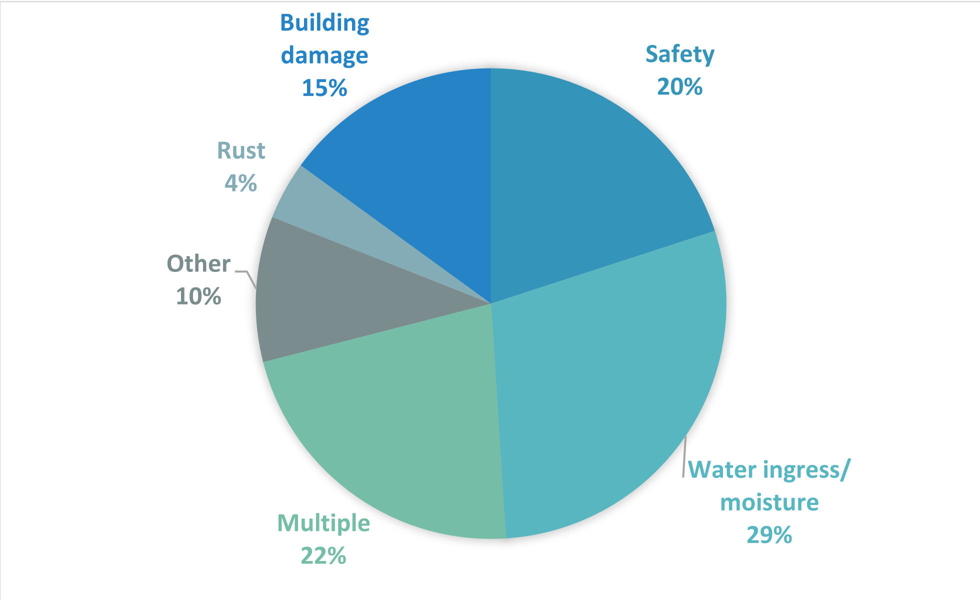
Across the 13 construction systems, 40.19% (n = 1297) of the defects identified in the reports were categorised to building fabric and cladding, followed by fire protection (13.26%, n = 428), water proofing (11.46%, n = 370), roof and rainwater disposal (8.58%, n = 277), and structural (7.25%, n = 234). The remaining systems: hydraulics, safety, electrical, lighting and data, mechanical and ventilation, access and egress, non-essential elements, in motion equipment and utility supply had 5% or less of the defects identified categorised under these systems.

Figure 2: Percentage of Defects by Construction System across all Jurisdictions



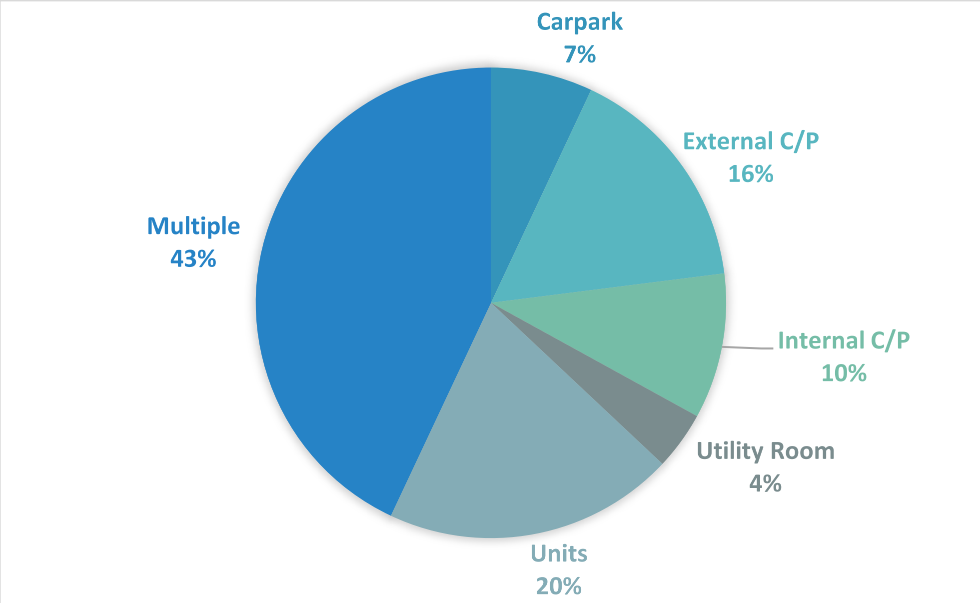
The audit reports provided detailed commentary regarding the identified defects including the impact(s) the defect had on the particular building (identified in this report as consequences) and other defects that have or may have contributed to the particular identified defect. When analysing all the construction systems, water ingress and moisture were identified as the most prevalent consequence and contributor to building defects (29%, n = 936) followed by multiple consequences and contributors (22%, n = 710), safety (20%, n = 645), building damage (15%, n = 484), other (generic category – 10%, n = 322) and rust (4%, n = 129).

Figure 3: All Construction Systems – Consequences and Contributors



The building audit reports identified the location(s) within the schemes where the defect was located. Some reports specifically identified areas within the common property but others were more general. Where possible, the analysis identified specific locations within the common property. As highlighted in Figure 4, 43% of defects were located in multiple locations throughout the scheme, 20% were located within units, 16% were noted as external common property defects, 10% were noted as internal common property defects, 7% were in car parks and 4% were in utility rooms.

Figure 4: Identified Defects by Location – across all Jurisdictions



4.1.2 Construction System: Access and Egress

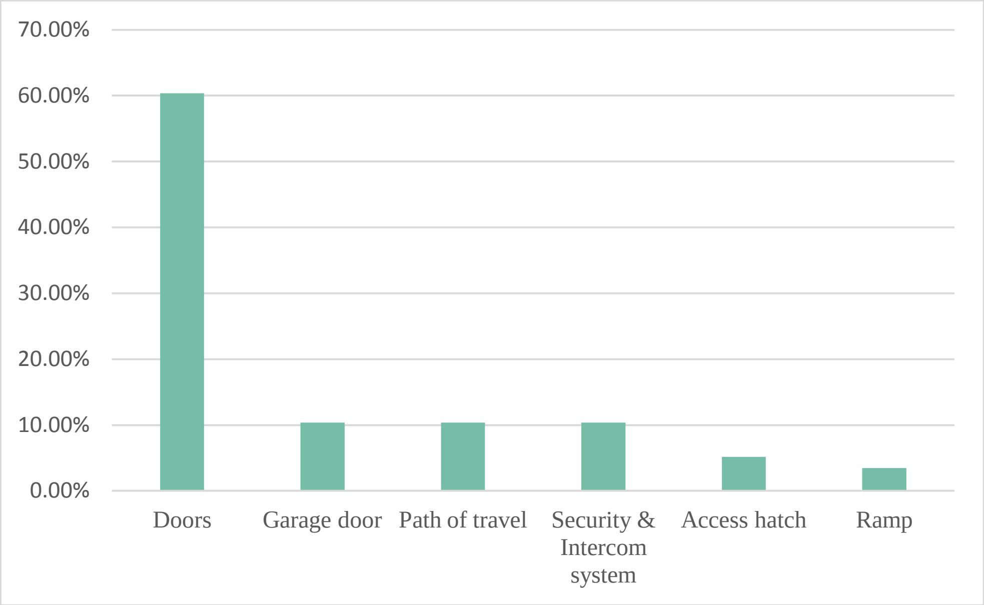
Access and egress as a construction system relates to the entry and exit of a building. More specifically, the system ensures sufficient control measures are in place to allow the safe movement into and out of a building. Volume 1, Section D of the NCC specifies the performance requirements for multi-residential buildings (Class 2 to 9) in relation to access and egress. There are nine specific areas of focus when constructing new buildings including: access for people with a disability, safe movement to and within a building, fall prevention barriers, exits, fire-isolated exits, paths of travel to exits, evacuation lifts, car parking for people with a disability, communication systems for people with hearing impairment. For the purpose of this study, some of the access and egress requirements are located under other construction systems (for example, fire protection).

Of the defects identified in the audit reports, less than 5% related to access and egress. However, of the reported access and egress defects 60% related to doors, specifically door hardware. Door hardware issues fit within the 'safe movement to and within a building' performance requirement under the NCC. Any door installed must not impede a person's ability to exit a building.

Table 6: Access and Egress Sub-categories and Defect Examples

Access & Egress: Sub-categories	Examples of Defects Reported
• Access hatch	Hatch prematurely corroded, lack of inspection hatch
• Doors	Defective door hardware
• Security & intercom systems	Intercom not working, incorrect key system on fire services door, defective locks
• Garage doors	Faulty door mechanism, lack of manual override, gate motor inadequate for gate weight
• Path of travel	Access pathways less than required width, entry door swing not in direction of egress
• Ramps	Access or entry ramp non-compliant

Figure 5: Access and Egress - Percentage of Defects across Jurisdictions



4.1.3 Construction System: Building Fabric and Cladding

Building fabric and cladding refers to any product or material that is applied over another product or material to provide a skin or layer. These products or materials often provide thermal and sound insulation, weather and vermin resistance and improve building aesthetics.

The largest number of defects identified in the audit reports were categorised under the building fabric and cladding construction system. After the initial analysis, 17 sub-categories were identified under this system and each defect was then coded to one of the sub-categories. Table 7, highlights the sub-categories and examples of the defects coded to these sub-categories.

Table 7: Building Fabric and Cladding Sub-categories and Defect Examples

Building Fabric & Cladding: Sub-categories	Examples of Defects Reported
• Joinery	Rotten timber beading, cornice delaminating, joinery prematurely deteriorating, water damaged skirting
• Lightweight cladding - ceilings	Ceiling suspension system failure, crack to plasterboard ceiling, lack of noise attenuation, water staining to ceiling
• Lightweight cladding – walls	Cladding not suitable for application, cracking to interface between dissimilar materials, cracking to plasterboard, flashings not installed to standard, missing flashings, cracked wall cladding and rusting fixings, water damaged and mouldy plasterboard, cracking to exterior walls, incorrect installation of Alucobond cladding system
• Lightweight cladding – soffit	Corrosion of soffit fixings, soffit incomplete, defective installation of soffit, efflorescence and rust to concrete soffit
• Lightweight cladding – floors	Incorrect installation of timber flooring, deterioration of timberwork
• Masonry – brickwork	Cracking to garden planter boxes, deterioration of face brickwork, render system delamination, incorrect installation of render system, inconsistent or missing mortar to brickwork, weep holes covered
• Masonry – efflorescence	Efflorescence to brickwork and tiles, efflorescence to concrete tilt panel, efflorescence to roofing slab
• Masonry – horizontal control joints	Lack of control joint to balustrade, expansion joint faulty, lack of control joints to tiled floors, cracking at control joint, lack of control joints to structural slab, lack of flexible joints to tiling junctions
• Masonry – tilt panels	Lack of caulking to concrete tilt panel, exposed reo to precast concrete panel, exposed ferrules to concrete tilt panel, missing sealant to concrete tilt panel
• Masonry – vertical articulation	Lack of control joints to blockwork wall, lack of control joints to garden planter walls, control joint omitted, flexibility of articulation joint compromised, control joint obstructed, differential movement cracking
• Plastering and rendering	Cracking to exterior cladding / render system, internal render cracking, plasterboard delaminating from substrate, defective render
• Sanitary fixtures	Faulty shower screen, leaking shower screen
• Slab – non-structural	Grade to balcony floor inadequate, corrosion to concrete slab soffit, lack of hob to balcony doors, redundant formwork left in situ, misaligned concrete paving, water ponding, exposed steel and concrete connection
• Stairs	Gaps to balcony handrails abutting wall, cracking to stairs
• Tiling and Carpeting	Defective tiling, delamination of tiling, drummy tiles
• Vermin proofing	Penetration to cladding unsealed, hole in wall not vermin proof
• Windows and doors	Incomplete window installation, defective door hardware, missing flashing to door head, water damage to window reveal, aluminium in contact with corrosive materials, door furniture incorrectly fitted

For this construction system, the sub-categories related to the same material or product were collapsed into one sub-category. Nine sub-categories were then analysed and the percentage of defects reported are highlighted in figure 6. The most prevalent defects reported relate to masonry structures (27.3%), which include brickwork, efflorescence, horizontal control joints, vertical articulations, and tilt panels. Following masonry structures the next prevalent defects related to lightweight cladding (23.75%), windows and doors (13.05%), plastering and rendering (11.4%), tiling and carpeting (9.17%), joinery (6.55%), slab (non-structural) (6.5%), vermin proofing (1.3%) and other (1%).

Figure 6: Building Fabric and Cladding - Percentage of Defects across Jurisdictions

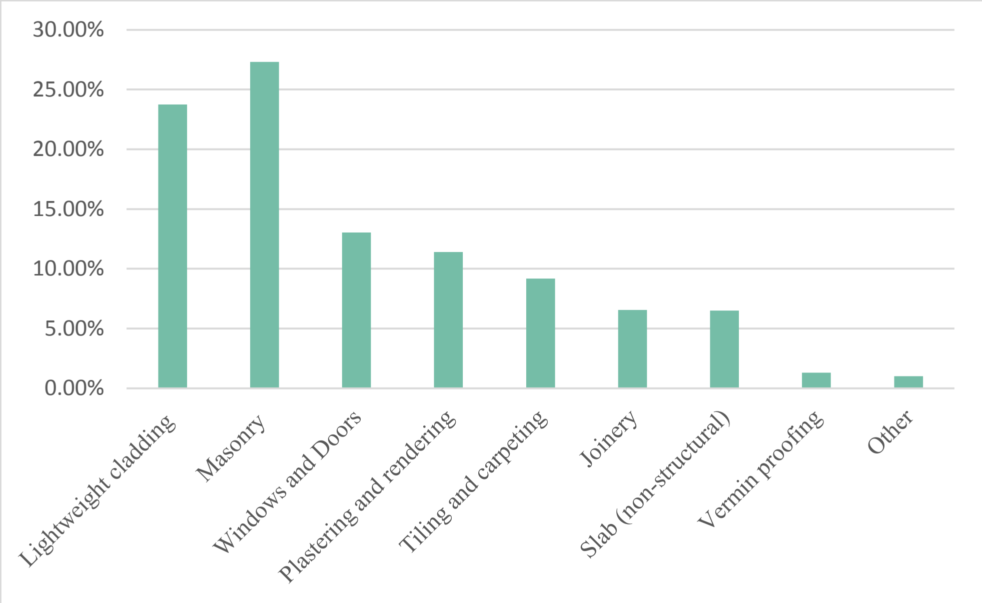
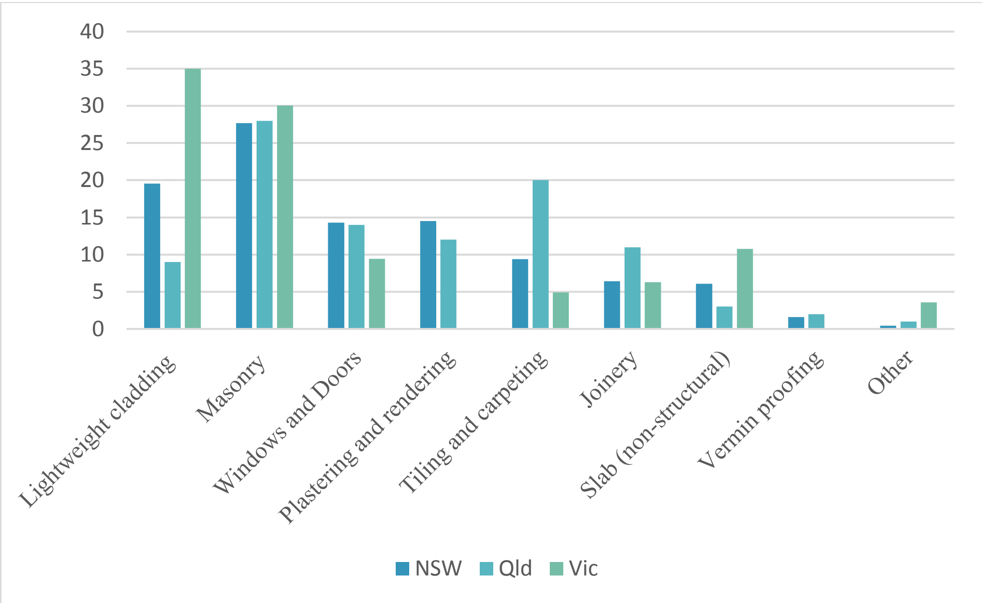


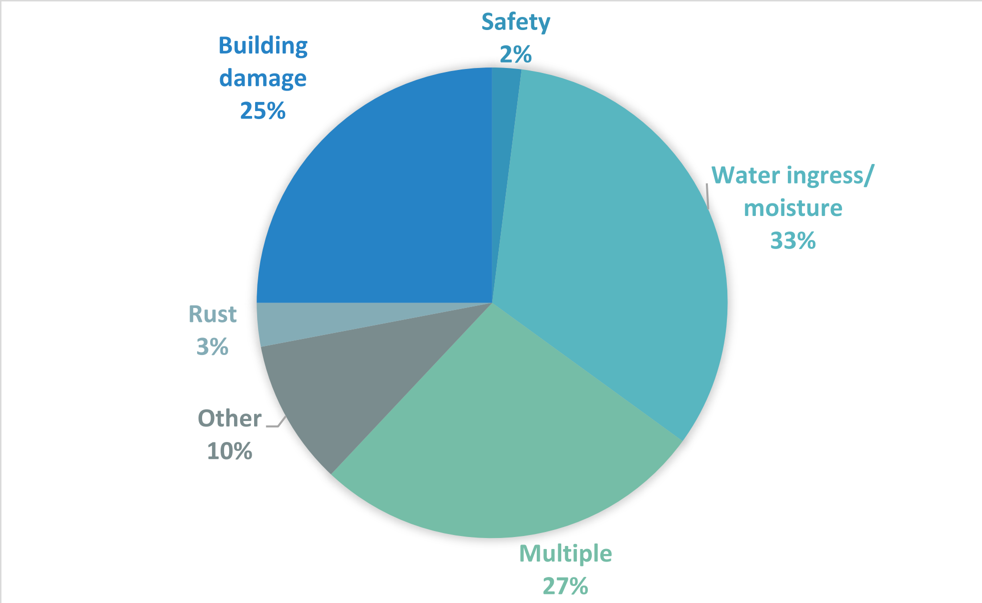
Figure 7, highlights the variations between the States in relation to the building cladding and fabric sub-categories. Of note, is the difference between the States in relation to lightweight cladding, plastering and rendering (Victoria unreported) and, tiling and carpeting.

Figure 7: Building Cladding and Fabric - Percentage of Defects for NSW, Vic and Qld



The consequences of and contributors to building fabric and cladding defects are highlighted in Figure 8. Water ingress and moisture contributes to 33% of the defects relating to this construction system. Multiple (27%) consequences and contributors were also reported. Building damage was also noted as a consequence (25%) of the defects reported.

Figure 8: Building Fabric and Cladding – Consequences and Contributors



4.1.4 Construction System: Electrical, Lighting and Data

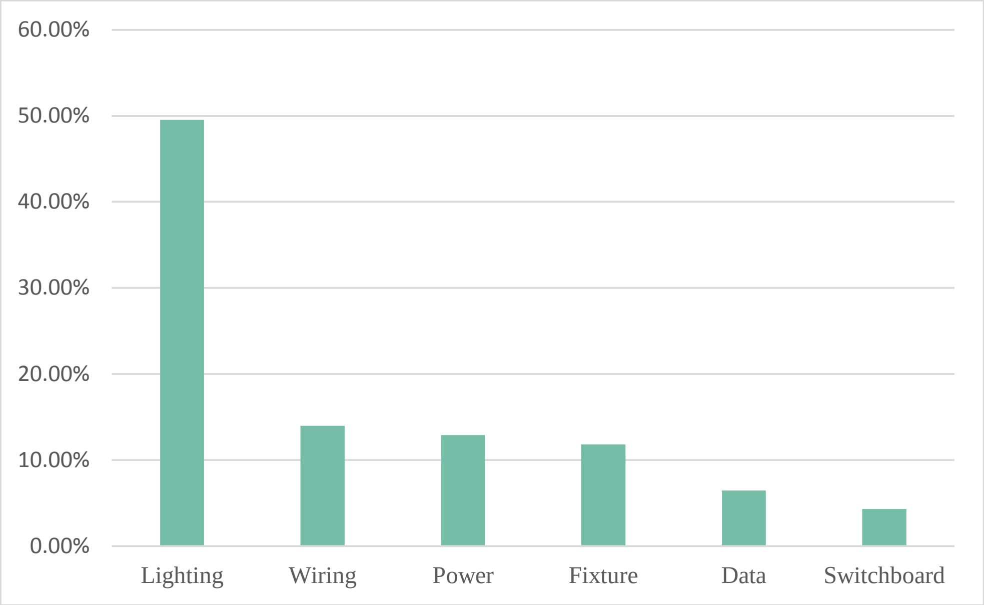
The electrical, lighting and data construction system relates to safe installation and connection of electricity-based elements including lighting and wiring.

Defects relating to the electrical, lighting and data construction system constituted 2.88% of all defects in the sample. Table 8, identifies the five sub-categories created for this construction system based on the defects outlined in the reports. The table provides examples of the type of defects reported relevant to each sub-category. As highlighted in Figure 9, the majority of defects reported relate to lighting faults, followed by wiring (14%), power (13%), fixture, data and switchboard.

Table 8: Electrical, Lighting and Data sub-categories and Defect Examples

Electrical, Lighting & Data: Sub-categories	Examples of Defects Reported
• Lighting	Defective installation of light post, fixture not fixed correctly
• Power	Poor installation of GPO
• Wiring	Exposed wiring, non-compliant electrical works
• Data	Poor workmanship data cabling
• Switchboard	Premature corrosion of electrical meter box, defective switch board / metering works

Figure 9: Electrical, Lighting and Data - Percentage of Defects across Jurisdictions



4.1.5 Construction System: Fire Protection

The major components relating to fire safety in buildings are fire prevention, fire detection (including warnings) and escape, fire containment and control (restricting the spread of fire), and fire extinguishment.[81] The NCC, Section C of Volume 1 provides the Performance Requirements regarding fire resistance, which includes ensuring buildings have elements that maintain structural stability during a fire and avoid the spread of fire. The building must, amongst other things, be constructed in a manner that, in the event of a fire, allows sufficient time for an orderly evacuation of residents and protects essential fire safety elements. Section E of the NCC outlines the Performance Requirements for fire services and equipment and includes the installation of fire hose reels, extinguishers, fire hydrants and automatic fire suppression systems. Section B, Volume 3 of the NCC provides the Performance Requirements for fire fighting water services.

Defects relating to the fire protection construction system constituted 13.26% of all defects in the sample (the second most prevalent system). Table 9, identifies the 11 sub-categories created for this construction system based on the defects outlined in the reports. The table provides examples of the types of defects reported relevant to each sub-category.

[81] H Leslie Simmons, *Construction: Principles, Materials, and Methods* (John Wiley & Sons, 7th ed, 2001); National Construction Code, Volume 1 - Definition section (schedule 3).

Table 9: Fire Protection Sub-categories and Defect Examples

Fire Protection: Sub-categories	Examples of Defects Reported
• Active – Fire Doors	Fire door seal incomplete, water damaged fire door, fire door hardware defective, incorrect / no signage to exit doors, fire door non-compliant, missing fire door hardware
• Active – Dampers	Damaged fire damper to access hatch
• Escape – Lighting	No or incorrect exit signage, emergency light not working
• Escape – Obstructions	Exit pathway obstructed, lockable security screen obstructing fire door, trip hazards in fire escape pathway
• Escape – Plans	Inconsistent emergency evacuation plans
• Fire Fighting Equipment	Extinguisher missing, fire protection tags out of date, insufficient clearance around fire hose reel
• Fire Hazards	Non-compliant combustible materials in fire rated zone, combustible materials in fire escape pathway
• Passive – Fire Penetration Seals	Missing fire collars, missing or incomplete fire separation to penetration, no fire barrier at penetration, multiple services in penetrations, fire seal to wall / slab junction is non-compliant, incorrect size fire collar, non-compliant concrete infill around service penetration, damaged fire rated wall
• Passive – Fire Separation	Compromised fire barrier, cracking to fire rated ceilings, lack of appropriate fire separation between units, fire seal missing, incorrect material used for fire barrier
• Warning & Detection Systems	Incomplete installation of fire detection system, lack of fire detection system, missing smoke detectors
• Water-based Systems	Hydrant valve clearance insufficient, fire booster valve prematurely corroded, incomplete installation of fire sprinkler system, premature corrosion of fire sprinkler system

For ease of analysis, related sub-categories were collapsed into one sub-category. Figure 10, highlights the percentage of defects reported in these new sub-categories. Defects relating to passive fire systems (fire penetration seals and fire separation) were the most prevalent (45%), followed by active fire systems (fire doors and dampers) (21.73%), then escape-based defects including lighting, obstructions and plans (14.25%) and fire fighting equipment (7.71%).

Figure 10: Fire Protection - Percentage of Defects across Jurisdictions

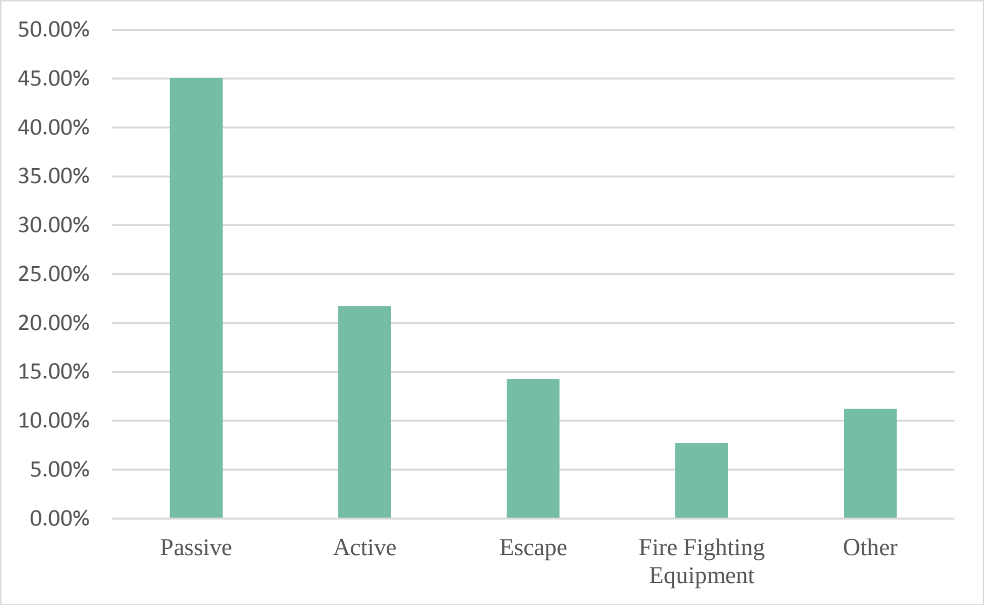
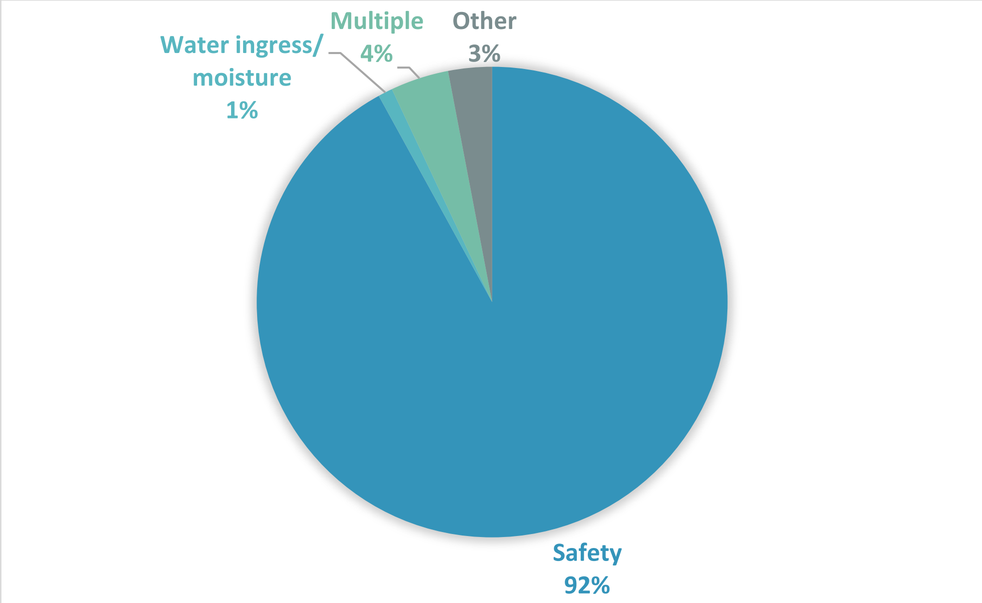


Figure 11, highlights the variations across the States in relation to fire protection system defects. There is general consistency across the passive and active systems with variations noted in relation to escape and fire fighting equipment.

Figure 11: Fire Protection - Percentage of Defects for NSW, Vic and Qld

As highlighted in Figure 12, safety is the main consequence for failures in the fire protection system of buildings with 92% of defects reported relating to safety concerns.

Figure 12: Fire Protection – Consequences and Contributors



4.1.6 Construction System: Hydraulics

The hydraulics construction system specifically relates to the installation and supply of cold and hot water, non-drinking services, and plumbing and drainage (including sanitary plumbing services). Volume 3 of NCC (Sections B, C and D) provides the Performance Requirements for hydraulics which includes, amongst other things, ensuring that: cold and hot water is connected to drinking water supply, the water is provided at the required flow rates and pressures, appliances and devices can be isolated for testing, hot water is delivered at a temperature unlikely to scald, legionella controls are in place, and services are designed, constructed and installed to avoid cross-contamination. The Performance Requirements provide that sanitary plumbing systems must ensure: sewage is transferred to the appropriate drainage system, access is provided for maintenance, and ventilation is provided. Noise controls must also be implemented in relation to plumbing and drainage systems.

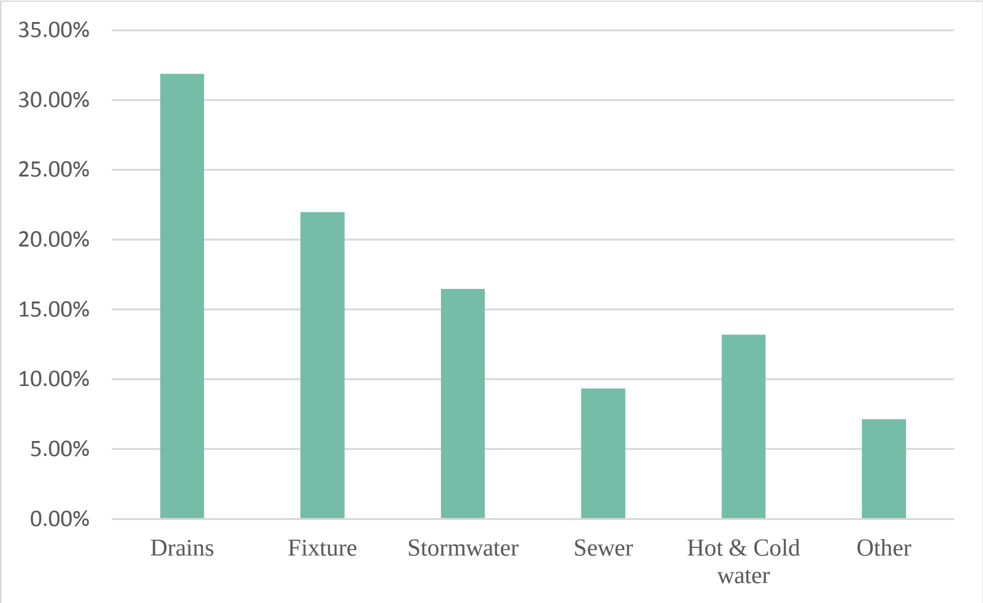
Defects relating to the hydraulics construction system constituted 5.63% of all defects in the sample. Table 10, identifies the nine sub-categories created for this construction system based on the defects outlined in the reports. The table provides examples of the type of defects reported relevant to each sub-category.

Table 10: Hydraulics Sub-categories and Defect Examples

Hydraulics: Sub-categories	Examples of Defects Reported
• Cold water	Cold water overflow trays missing, leaking water meter, cold water incorrectly installed to tap
• Drains	Inadequate drainage provisions, no overflow provision to balcony, poor alignment of drain to paving, ineffective / defective drainage installation, drain face higher than surrounding surface, inadequate drainage provisions to planter box
• Hot water	Hot water overflow trays missing, incorrect installation of hot water service, no temperature gauge to hot water system, leaking hot water service pressure valve
• Fixtures	Excessive corrosion of plumbing fixture, incorrect installation of sanitary fixture, defective sink installation, leaking fixture
• Pumps	Sump pump blockage, pump malfunctioning
• Sewer	Leaking sewer pipe, slow discharge to sewer from fixtures
• Stormwater	Leaking pipe, incorrect installation of stormwater drain, premature corrosion to pipework
• Tanks	Defective water tank installation
• Gross pollutant traps	No tap to charge gully trap

As highlighted in Figure 13, hydraulic related defects as reported included: faults relating to drains (32%), fixtures (22%), stormwater (16%), and hot and cold water (13%).

Figure 13: Hydraulics - Percentage of Defects across Jurisdictions



4.1.7 Construction System: In Motion Equipment

Although many types of conveying (in motion) systems are used in buildings, lifts are the most common in residential buildings. Part E3 (Services and Equipment) of the NCC provides Performance Requirements in relation to lift installation including for the provision for stretcher facilities, emergency alerts and access for people with disabilities.

Only 0.15% of the defects reported related to in motion equipment (or lifts).

Table 11: In motion Equipment Sub-categories and Defect Examples

Motion Equipment: Sub-categories	Examples of Defects Reported
Lifts	Exposed lifting lugs to lift shaft wall, defective installation of panelling, lift sump pump and installation not fit for purpose

4.1.8 Construction System: Mechanical and Ventilation

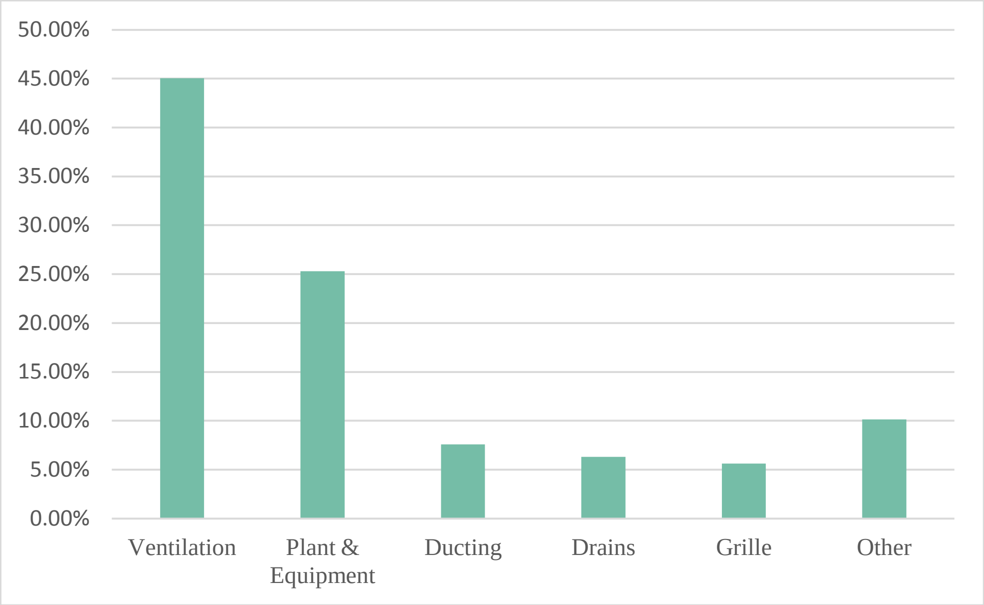
Part 4F (Health and Amenity) of the NCC provides Performance Requirements for light and ventilation in buildings. The Requirements provide that buildings are constructed to ensure natural light is distributed throughout, that artificial lights provide adequate luminance to ensure safe passage, spaces used by occupants are ventilated with outdoor air, and mechanical air-handling systems control odours and harmful contaminants.

A small number of building defects (2.45%) related to the mechanical and ventilation construction system. Although eight sub-categories were identified, the majority of defects related to ventilation (45%) and plant equipment (25%) (Figure 12).

Table 12: Mechanical and Ventilation Sub-categories and Defect Examples

Mechanical &Ventilation: Sub-categories	Examples of Defects Reported
• Plant & Equipment	Metal conduit deformed, vent cover not sealed to external cladding, lack of weather protection to plant, inoperable fan
• Ducting	Excessive corrosion to vent, ducting not attached to junctions or fixtures, water ingress at duct flashing
• Pumps	Unsuitable pump cover, failure of pump
• Drains	Broken drain to plant, condensate drains disconnected from plant, condensate drains incorrectly discharging to balcony floor
• Air-conditioning	Air-conditioning unit has no drain connection, defective air-conditioning unit
• Grilles	Premature corrosion to ventilation grilles, missing grille to vent, leak to vent shaft cover
• Ventilation	Lack of adequate ventilation causing condensation and mould, defective ventilation system to amenities area, inadequate sub-floor ventilation, lack of ventilation to bathroom / laundry, lack of ventilation to plant
• Pipework	Premature deterioration of pipe lagging

Figure 14: Mechanical and Ventilation - Percentage of Defects across Jurisdictions



4.1.9 Construction System: Roof and Rainwater Disposal

Part F (Health and Amenity) of the NCC outlines the Performance Requirements for rainwater impacts and weatherproofing buildings. The Performance Requirements provide that roof and rainwater disposal must be managed in a way that avoids the likelihood of damage to any other properties, prevents rainwater from entering buildings, provides drainage systems that convey water to outfalls, and provides weatherproofing that prevents undue dampness or deterioration of building elements.

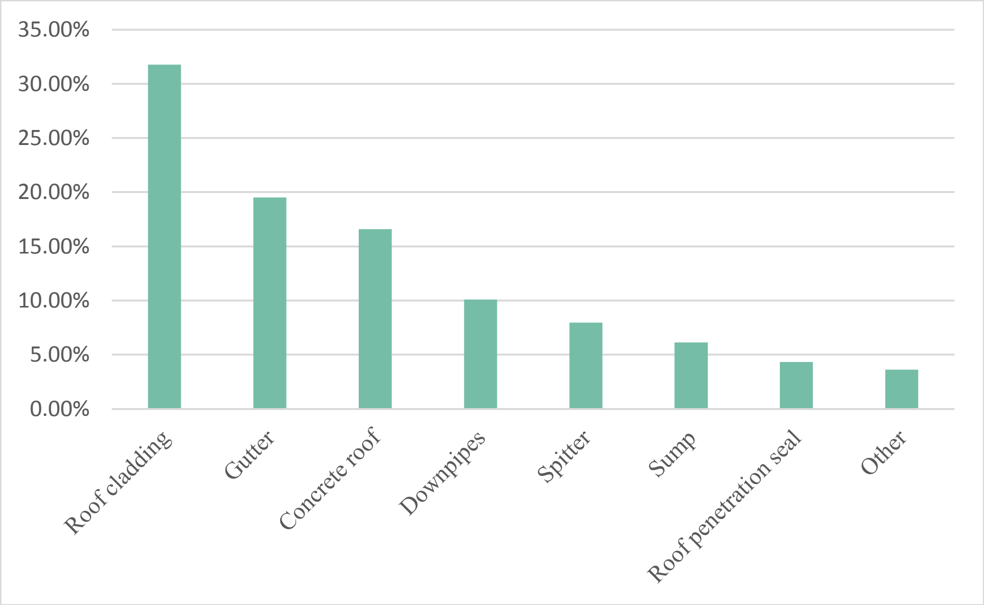
Defects relating to the roof and rainwater disposal construction system constituted 8.6% of all defects in the sample. Table 13, identifies the nine sub-categories created for this construction system based on the defects outlined in the reports. The table provides examples of the types of defects reported relevant to each sub-category.

Table 13: Roof and Rainwater Sub-categories and Defect Examples

Roof & Rainwater: Sub-categories	Examples of Defects Reported
• Concrete roof	Inadequate grade to drains on roof slab, membrane failure / defective installation, water ingress around service penetration, lack of applied membrane where required, missing membrane to roof parapet
• Downpipes	Inadequate drainage, incorrect installation of downpipe, incorrect installation of spreaders, lack of adequate fixings to downpipes, premature corrosion to downpipe brackets
• Filtration	Rusting tank filters
• Gutter	Box gutter lacks overflow provisions, gutter guard restricting rainwater flow, inadequate fall to box gutter, incorrect installation of box gutter, leaking roof gutter
• Roof cladding	Defective installation of roof sheeting, incorrect installation of flashings, inadequate fall to roof sheeting, missing roofing screws, damaged roof sarking and insulation
• Roof Penetration Seal	Incorrect installation of dektite and flashings, inadequate flashing to service penetration,
• Skylight	Incorrect installation of skylights to roof
• Sump	Soaker pit not draining, stormwater drain undersized, incorrect installation of rain head
• Spitter	Leaking drain to balcony, balcony lacks overflow drain, ponding of water on balcony

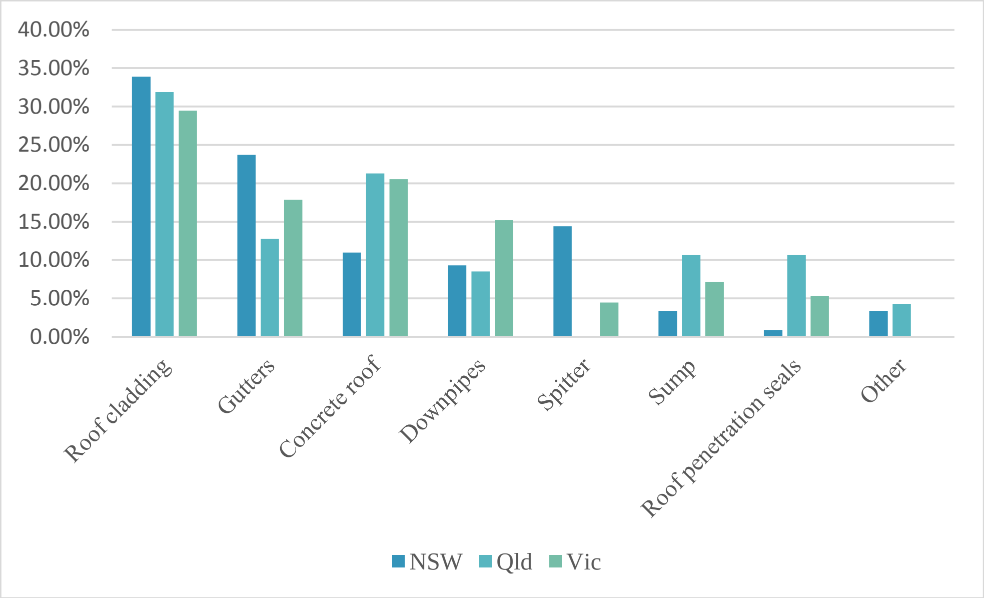
Figure 15 highlights the areas in which the defects were most prevalent in the roofing and rainwater disposal system. The majority of defects related to roof cladding (32%), followed by gutters (20%), concrete roofs (17%), downpipes (10%), spitters (8%), sumps (6%), and roof penetration seals (4%).

Figure 15: Roofing and Rainwater Disposal - Percentage of Defects across Jurisdictions



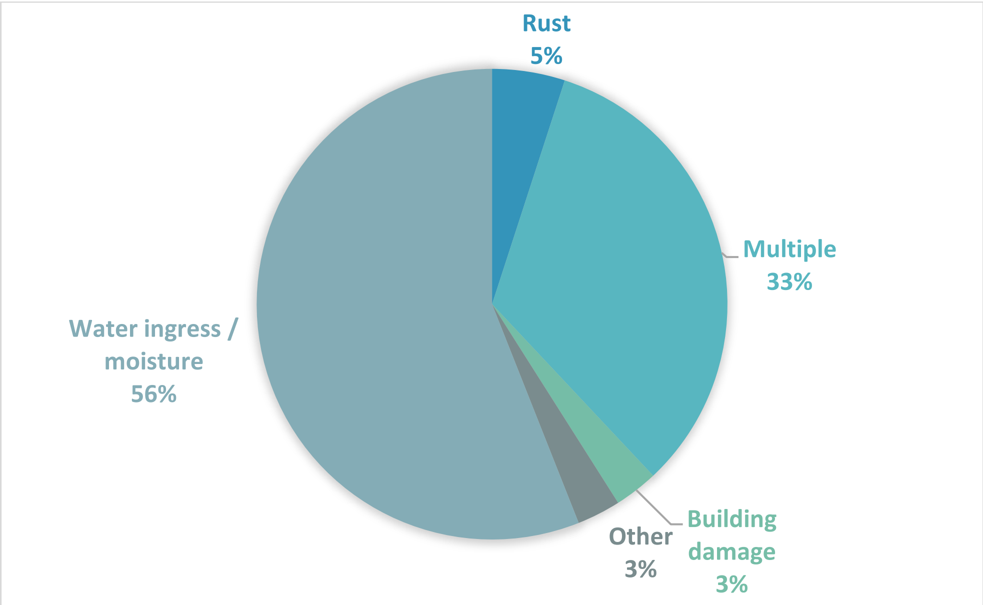
By way of comparison, Figure 16 highlights the difference between the States in terms of identified roof and rainwater defects. There is overall consistency with slight variations in relation to gutter and concrete roof defects.

Figure 16: Roofing and Rainwater Disposal - Percentage of Defects for NSW, Vic and Qld



The main consequence of roofing and rainwater disposal defects is water ingress and moisture (56%) into the building. Multiple other consequences and contributors were also noted (33%) along with rust and building damage (Figure 17).

Figure 17: Roofing and Rainwater Disposal – Consequences and Contributors



4.1.10 Construction System: Safety

The safety construction system relates to hazard prevention. Measures must be undertaken to safeguard building occupants. An example provided in the NCC relates to glass installation. Section B requires that glass installations that are at risk of causing harm if shattered must have specific glazing that will break in a way that is not likely to cause injury.

Defects relating to safety systems constituted 5.26% of all defects in the sample. Table 14, identifies the eight sub-categories created for this construction system based on the defects outlined in the reports. The table provides examples of the type of defects reported relevant to each sub-category.

Table 14: Safety Sub-categories and Defect Examples

Safety: Sub-categories	Examples of Defects Reported
• Disabled access	Non-compliant disabled access
• Fall arrest system	Balustrade incomplete, inadequate height to handrail on stairs, anchor points not fit for purpose, handrail missing fixings, climbable ledge adjacent to balustrade, non-compliant balustrade
• Hazardous materials	Building debris within service riser
• Impact damage protection	Wheel stoppers not fixed to concrete slab, bollard protection missing
• Risers and treads	Inconsistent risers heights to stairs, inadequate clearance between handrails to stairs, steel stair stringer corrosion
• Tactile indicators	Incorrect placement of tactile indicators to public pathway,
• Trip & fall hazard	Stair treads lack non slip surface, sash window opens into path of travel
• Visual indicators	Non-compliant safety glass, missing safety decals
• Pedestrian & traffic safety	Lift doors open into pathway of vehicles

Figure 18: Safety - Percentage of Defects across Jurisdictions

4.1.11 Construction System: Structural

Section B (Structures) of the NCC specifies the Performance Requirements for the structural construction system. The Requirements provide that buildings are to be constructed to ensure structural reliability and resistance. More specifically, buildings must perform under all reasonable expected design actions including climatic actions, ground movement, site works etc.

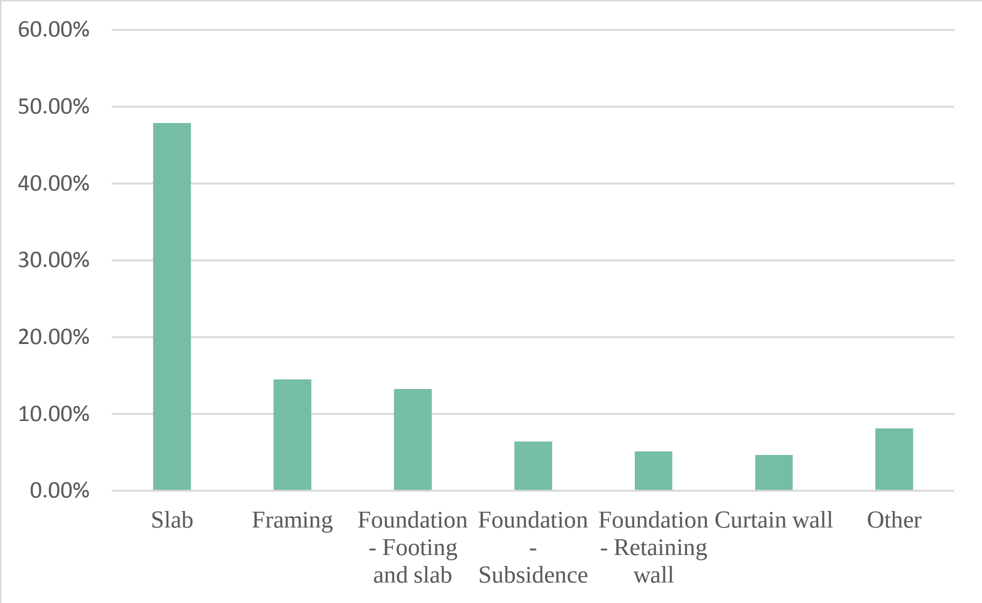
Defects relating to the structural construction system constituted 7.25% of all defects in the sample. Table 15, identifies the 13 sub-categories created for this construction system based on the defects outlined in the reports. The table provides examples of the type of defects reported relevant to each sub-category.

Table 15: Structural Sub-categories and Defect Examples

Structural: Sub-categories	Examples of Defects Reported
• Curtain Wall – Engineered Walling System	Incorrect installation of proprietary masonry wall system
• Curtain Wall	Differential movement of structural elements causing cracking to walls
• Curtain wall – Tilt Panel	Cracking to concrete tilt panel, concrete spalling at precast panel connection plate
• Foundation – Footing and Slab	Inadequate hob to balconies, lack of isolation joints to structural slab and basement elements, exposed reinforcing to slab, cracking to driveway slab
• Foundation – Retaining Wall	Minor cracking to structural basement wall, retaining wall failure
• Foundation - Subsidence	Subsidence to paving slab, subsidence to ground abutting buildings, excessive ground settlement
• Foundation – Lift Shaft	Cracking to lift shaft walls
• Framing	Rust to structural columns, rotten timber framing, structural beam compromised, incorrect installation of structural bolts to structural element
• Framing - Roof	Incorrect installation of roof trusses
• Slab	Cracking to structural slab, inadequate grading of floors, structural failure of balcony, excessive movement of structural slab / wall junction, concrete spalling
• Stairs	Rust to structural stair formwork
• Crossover	Street crossover poorly constructed
• Soundproofing	Lack of sound isolation to service installation

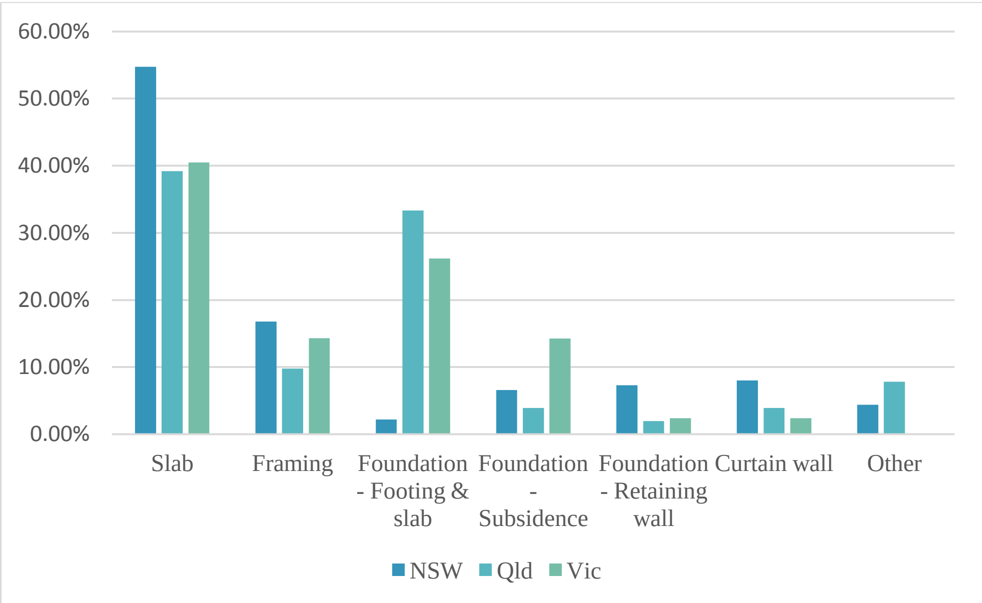
Figure 19, highlights the percentage of reported defects relating to building structure. Defects impacting the slab (i.e. concrete issues unrelated to ground movement) were most prevalent (48%), followed by framing (14.5%), foundation footing and slab (i.e. issues arising out of ground movement – possible footing failure, such as cracking) (13%), foundation subsidence (6%), foundation retaining walls (5%) and curtain wall (4%).

Figure 19: Structural - Percentage of Defects across Jurisdictions



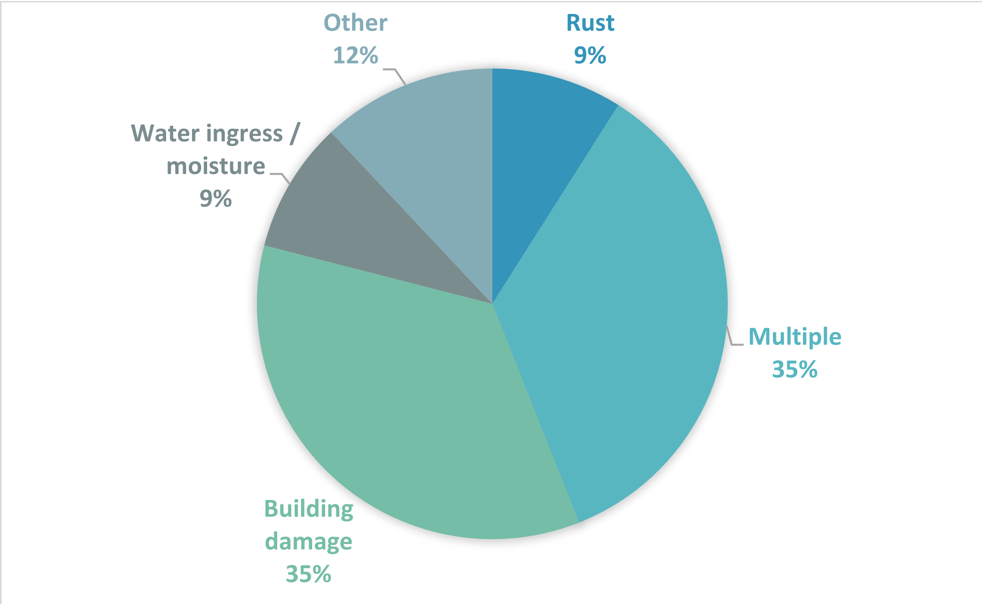
There is some variation between the States in relation to the defects allocated to the structural construction system. New South Wales reported more defects relating to slabs than the other States but less in relation to foundation defects (footing and slab and subsidence) (see Figure 20).

Figure 20: Structural - Percentage of Defects for NSW, Vic and Qld



The reports identified that structural defects resulted in building damage (35%) and multiple other impacts (35%), followed by other consequences and contributors, water ingress and moisture and then rust.

Figure 21: Structural – Consequences and Contributors



4.1.12 Construction System: Utility Supply

Utility supply as a construction system refers to the supply to, or expulsion of, resources or materials from the property scheme. Such services include, the supply of water, electricity and gas or the expulsion of waste. A local government authority or resource wholesaler often provides these services.

Defects relating to the utility supply system constituted 0.15% of all defects in the sample. Table 17, identifies the two sub-categories created for this construction system based on the defects outlined in the reports. The table provides examples of the type of defects reported relevant to each sub-category.

Table 16: Utility Supply Sub-categories and Defect Examples

Utility Supply: Sub-categories	Examples of Defects Reported
• Waste disposal	Garbage chute brackets rusting
• Gas	Incorrect installation of gas appliance

4.1.13 Construction System: Waterproofing

As highlighted above, Part F (Health and Amenity) of the NCC outlines the Performance Requirements for rainwater impacts and weatherproofing buildings. The Requirements for weatherproofing (non-roof areas) provide that: external walls including windows and doors must prevent the penetration of water and undue dampness or deterioration of building elements, rising damp moisture must be prevented, wet areas and wet area overflows must be prevented from penetrating other units, public spaces, behind fittings and lining, and into concealed spaces.

Defects relating to the waterproofing construction system constituted 11.46% of all defects in the sample. Table 17, identifies the nine sub-categories created for this construction system based on the defects outlined in the reports. The table provides examples of the type of defects reported relevant to each sub-category.

Table 17: Waterproofing sub-categories and defect examples

Waterproofing: Sub-categories	Examples of Defects Reported
Membrane – balcony	Failure of membrane to balcony, lack of applied membrane where required, lack of membrane upturn / termination
Membrane – caulking seals	Sealant failure to junction of different materials, caulking failure
Membrane – internal wet areas	Defective installation of membrane, inadequate fall to shower base
Membrane – lift shaft	Water ingress to lift shaft
Membrane – parapet & walls	Membrane failure / defective installation
Membrane – podium	Failure of waterproof membrane, failure of dry basement system, lack of applied membrane where required, drip trays installed to combat underlying water ingress issues
Membrane – planter boxes	Failure of membrane to planter box
Membrane - water tank	Leaking water tank / failure of waterproofing system
Membrane – windows and door reveals	Water ingress around window, defective flashing
Paint	Blistering paintwork, incomplete painting works, localised cracking and delamination of paintwork
Damp proof course	Dampcourse not installed to brickwork, lack of dampcourse flashings

Membrane related defects were the most prevalent defects reported – balcony (28%), internal wet areas (19%), podium (10.5%), windows and doors (8.6%), caulking seals (7%), planter boxes (5%). Defects relating to paint failures were also a prevalent defect (19%) (Figure 22).

Figure 22: Waterproofing - Percentage of Defects across Jurisdictions

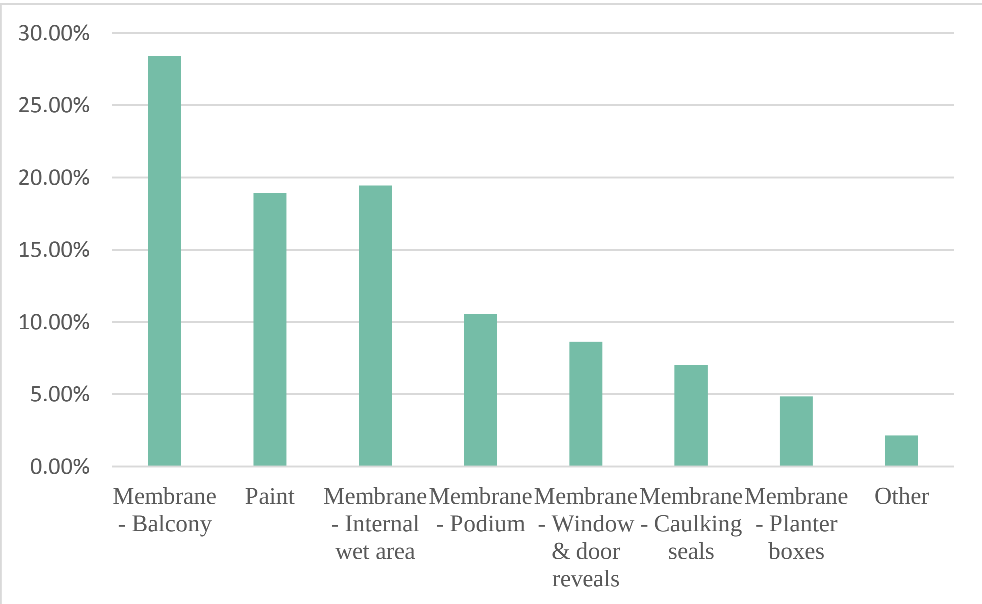
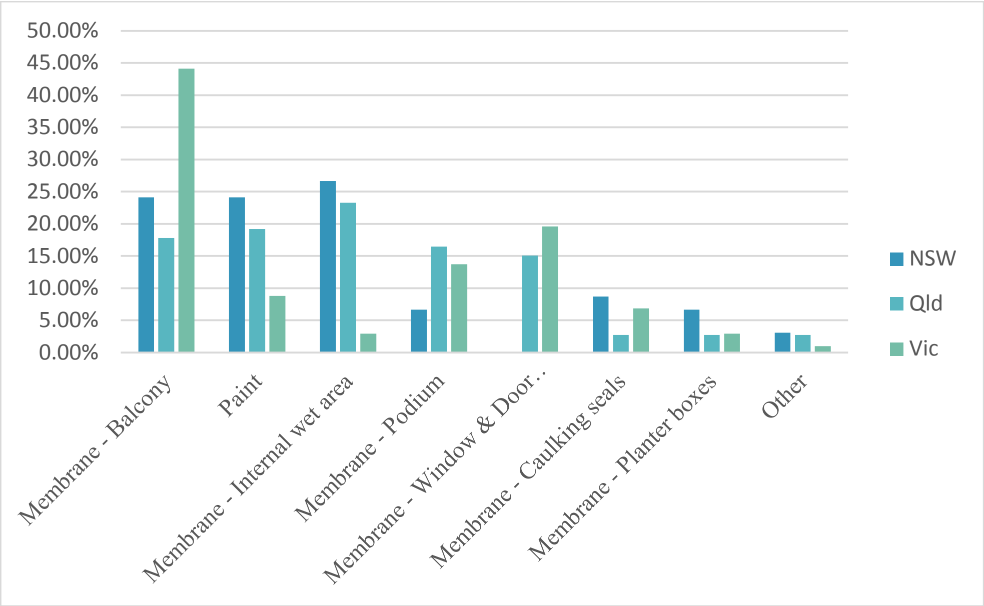


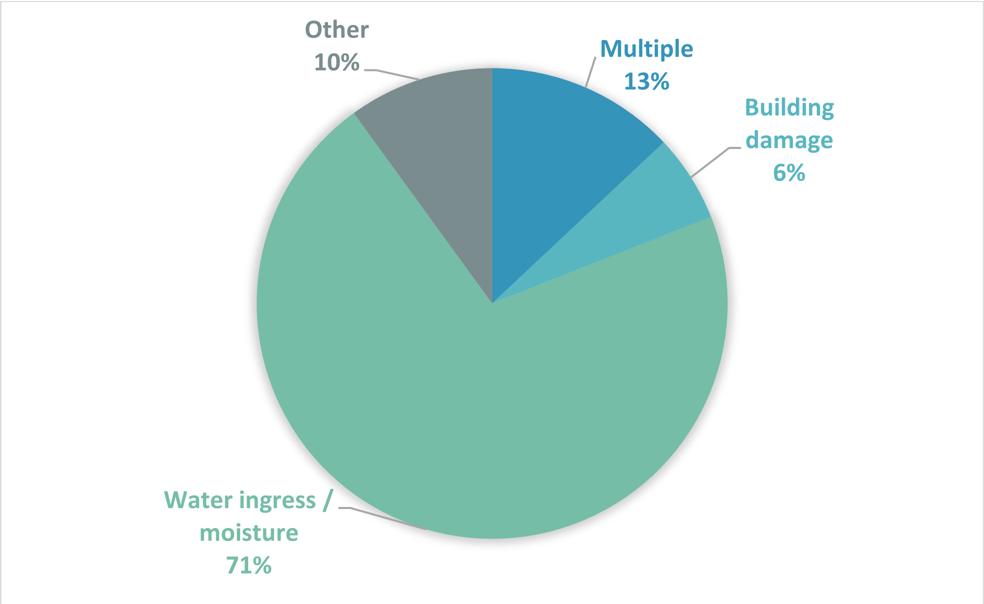
Figure 23 highlights the variations across the States in relation to waterproofing defects. Victoria reported a higher proportion of balcony membrane defects but less membrane defects relating to internal wet areas and paint.

Figure 23: Waterproofing - Percentage of Defects for NSW, Vic and Qld



The main consequence of waterproofing defects is water ingress and moisture (71%). Other consequences and contributors were: multiple (13%), other (10%) and building damage (6%) (Figure 24)

Figure 24: Waterproofing – Consequences and Contributors



4.1.14 Construction System: Non-essential Services

The ABMA Building Management Code defines non-essential services as "systems elected to be incorporated into the design [of a building] for the purposes of amenity and recreation for the end-users."[82] Non-essential services do not aid in the stability of buildings nor do they aid in the health and safety of building occupants. Such services usually include: swimming pools, spas, saunas, landscaping, soft furnishings, recreational facilities, gymnasiums, furniture, signage and playground equipment.[83]

The majority of defects reported in this category related to swimming pools. Section C, Volume 3 of the NCC outlines the Performance Requirements for swimming pool drainage, water recirculation systems and cool rooms. The Code requires swimming pool drainage to be installed so it does not cause illness to people or affect other property. Other non-essential structures that were noted in the defect reports related to fencing and ancillary structures such as pergolas.

Defects relating to non–essential services were rarely reported. Table 18, identifies the three sub-categories created for this construction system based on the defects outlined in the reports. The table provides examples of the type of defects reported relevant to each sub-category.

Table 18: Non-essential Services Sub-categories and Defect Examples

Non-essential Services: Sub-categories	Examples of Defects Reported
• Pool	Extensive leaks to swimming pool, incorrect fixings to pool balustrade, cracking to slab abutting pool
• Fencing	Gatepost inadequately braced, defective installation of fencing
• Ancillary structures	Unstable pergola / shade structure, corrosion to steel pergola

4.1.15 Relationships between Construction Systems

As highlighted at the beginning of this section, most buildings audited not only had multiple defects but multiple defects across different construction systems. As a result, we developed a correlation matrix to show correlation coefficients between the various construction systems. That is, we investigated whether relationships existed between systems and the strength of those relationships. Focusing specifically on the construction systems with the most prevalent reported defects, four relationships were identified as most notable. The construction systems with the highest positive correlations (i.e. there were found to be significantly associated) were:

1. Waterproofing and building fabric and cladding (r=+0.488, $p < .0001$)
2. Waterproofing and structural (r=+0.261, $p < 0.0008$)
3. Structural and building fabric and cladding (r=+0.258, $p < 0.0009$) and
4. Waterproofing and roof and rainwater disposal (r=+0.236, $p < 0.0025$)

These results are unsurprising given that water ingress and moisture was a constant contributor or consequence of defects relating to building fabric and cladding, roof and rainwater disposal and waterproofing systems. Similarly, building damage was a prevalent consequence of defects relating to building structure. These specific results highlight a large number of defects (48%) arising in the building fabric and cladding construction system are associated with waterproofing related defects. That is, they are resultant defects, not originating defects.

[82] Australian Building Management Accreditation (ABMA), *ABMA Building Management Code* (2018) Victoria Edition, 218.
[83] Ibid.

4.2 Interview Findings

Twenty-one stakeholders and end-users participated in the interview phase of this research project. Participants were asked to provide their opinion on a number of issues relating to building defects. Quotes have been extracted from the interview data to illustrate these opinions and the experiences of various stakeholders and end-users involved in dealing with defects (either directly or on behalf of others affected by building defects). To ensure anonymity, the participants' quotes have been given a reference number that (as outlined in the methodology section) identifies their professional background or interest and the State they are located. Although the interview process resulted in voluminous amounts of data, the research team has focused on several core areas. In some areas, additional information (regulatory notes) has been added to provide further context. We have demonstrated these findings by posing several questions:

4.2.1 To what extent does the regulatory environment impact on building quality, building defects and rectification?

Interview participants raised a number of concerns regarding the regulatory environment. The key areas of focus for participants were - the relationship between the NCC and the Australian Standards, rectification processes (particularly the lack of regulatory guidance), and the approach to regulatory reform.

When specifically addressing issues relating to the NCC and its reference documents, interviewees suggested there was a disconnect between the NCC and the Australian Standards. Examples were provided of Performance Requirements outlined in the NCC that are at odds with the relevant Australian Standard. One of the lawyer interviewees commented:

> ...you have a performance standard which says, "If you've got a large tall building the external walls need to be non-combustible," but there's two alternate pathways and you could say, "Well, it is a bonded laminate product. Even though it is combustible it's deemed non-combustible, so it's okay, it is a bonded laminate product." The definition of a bonded laminated product is a bit like it was drafted by Rumpelstiltskin, it's just completely nonsensical and it refers to – the relevant standard is about the AS 1530 Part 1. If you go to that standard it says, "This cannot be used for bonded laminate products." [21- Lawyer]

Other interviewees were bemused there were costs associated with obtaining Australian Standards. Although referenced in the NCC as a compliance document, the lack of open access to these Standards may create an access barrier for building professionals and trades particularly if the relevant Standards are costly or amended. The confidential nature of the Standards seems at odds with the purpose and objectives of the building regulatory environment.

> Effectively the Australian Standards need to start again to ensure rigour. [14 -Building Consultant]

> … regulatory oversight is so complex and convoluted and there are so many standards. A lot of the standards cost $300 for a licence to get a standard, to even look at the standard, the standard is a secret which is outstanding. In a lot of the cases we're seeing at the moment there's all these arguments about BCA compliance and loopholes in the BCA. [21- Lawyer]

Builders undertaking rectification works expressed their frustration about the Australian Standards. The general view being that Australian Standards and the NCC, more broadly, were not developed for remedial works but new construction. Therefore, remedial builders are left with little guidance when undertaking rectification works. As illustrated by one builder:

> If we're trying to apply the Australian Standards to a building that hasn't been built right in the first place, and we're not pulling the building down and putting it back up, we're trying to make it watertight and make best of what is here and we've got to reinvent the wheel every single job. And then you've

> got to think well the Australian standards won't apply to this, I can't apply something to a product that isn't right in the first place and we're not pulling the whole thing apart. [8 – Building Consultant]

Although a number of interviewees expressed concerns about the regulatory environment more broadly, one lawyer summed up their frustration with the Queensland system as follows:

> We've got a horrible regulatory environment in Queensland… it is a regulatory environment that has been put together on a piecemeal basis where bits don't talk to other bits. Although this will never happen in Queensland, we would be better off junking the QBCC Act and restarting and saying right, what are we doing here? Because there are things that get caught that are odd and there are things that aren't caught that are odd. For example – and this will never happen because they're too powerful – engineers and architects in Queensland are outside of the scope of the QBCC Act because they have their own bodies who want to make sure that they maintain being out of there, because that's the way it works. But it doesn't make any sense that when you have a building that's being built and the problem is, in fact, not the bloke who built it but the problem is the engineering drawings were wrong. That QBCC has to say, Mr Builder, you go back and fix that and Mr Builder goes, but hang on I just built what the engineer told me to build. What do you expect me to do? Rather than going to the engineer, hey engineer, you stuffed up, you do something about it. Same with the architect. And it really needs that kind of top down get everybody under the one umbrella approach. That's one aspect of it because if you do that you'll resolve a number of anomalies in the system. [3 - Lawyer]

4.2.2 What are the most common building defects being observed?

Failures in fire safety, water penetration and the building fabric were repeatedly mentioned as the most prevalent defects in residential multi-owned buildings. Combustible cladding and faults with balcony glass panels (shattering) were mentioned as a major concern in the past five years.

In relation to fire safety, the common defects observed by interviewees related to the absence of fire collars and seals, and the lack of fire barriers (separation).

> In terms of the majority of defects that I see probably in the last 10 years, and given that fact that we've been doing so much high-rise and multi-res construction in Queensland, there's been a lot of fire protection issues. And I made the facetious remark yesterday, "If you can find me a building that doesn't have fire protection issues in Queensland that was built between about 2004 and about 2010 please let me know because I don't know of any that don't have these issues." [3 - Lawyer]

As a building consultant explained the main fire safety faults in relation to a particular building project:

> Fire collars and fire protection systems, no barriers between lots in the sawtooth roof structure allowing for fire to jump between lots that was overlooked by the fire engineer [14- Building Consultant]

A private certifier and fire engineer discussed the inadequacy of fire protection measures particularly in relation to the lack of fire seals around various cables penetrating through walls.

> Fire separation. *That it's not there or…* It's either absent or it doesn't comply, it's not adequate enough. It doesn't comply. There's holes in it. It could be like Swiss cheese which is why one of the inspections that should be mandatory for me is at fire separation stage. [16 – Private Certifier]

> A lot of the apartment rooms there they've got all this stuff just running into the rooms and all the cable is through the same hole, it's not sealed. So basically every single room that we looked at from the foyer of each floor into the rooms didn't have their penetration seal where the cable was going in. You can't see it but if there was a fire and that combustion level got to the stage it would spread 'boom' straight out into the foyer. [6 – Fire Engineer]

When asked by interviewees how a building owner would know if there were a problem with fire separation, the common response was that they usually do not know. Inadequacies or faults with fire separation are uncovered when there is a fire, when other defects are detected or when remedial works are undertaken.

> They usually don't know until they've got a fire safety consultant involved. And more often than not, that's because there are other defects in the building and they've gone to a consultant or a lawyer and they've said, "Well there's a high chance you've also got a bunch of fire safety issues. You should have a fire safety consultant come in." And they go through and they pick up a bunch of problems. Sometimes it's built in a way where they can at least in some areas visually access a few cavities, and they can see there are problems here. And often they'll say let's open up holes – let's create a few manholes in a few areas. [2 - Lawyer]

One building consultant explained what commonly occurs when undertaking remedial work:

> It's typically if you were doing a bathroom, that bathroom will be neighbouring a common wall with the next door so that's got to have fire separation there. It's then when you open it up, you see what's not there. There is effort there, there is fireproofing there, but it just isn't the correct detail. And then once we see it, it can't be left and it needs to be dealt with [8 – Building Consultant]

Waterproofing and water ingress

Defects relating to waterproofing were identified as a constant and consistent problem in residential buildings. The specific type of failures identified included membrane failures and water penetration from skylights. As a consequence of water penetration, interviewees observed that: steel beams can become corroded, efflorescence on the façade becomes prevalent and mould inundation is present.

> Water penetrations externally, internally, balconies, bathrooms. Façade issues not as common, but a big issue if you've got them, in terms of water coming through façades. [13 - Manager]

> Roofs can always be complicated for people. Roofs always leak, particularly those flat roofs where they're again requiring membranes where they're not being put on properly. [5 - Lawyer]

> Water penetration through skylights…issues with corrosion of metal / steel facades and structural beams, incorrect installation and application of waterproof membranes in bathrooms, steel column ingress, lead paint flaking off steel beams due to corrosion / rust of the beams from water ingress, visual observation of efflorescence on the façade everywhere from water penetration, mould inundation [14 – Building Consultant]

Building Fabric and Cladding

Building fabric and cladding defects related to the absence of flashing around windows and doors, gaps in walls, problems with the external render and combustible cladding.

> This building had no flashing around brick work, doors and windows. Therefore, all the doors, windows and brick work had to be retrofitted with flashing. [17 – Committee Member]

> I've seen gaps in walls where you can put your hand through and stuff like that and they wouldn't be two years' old. The render just literally falling off the walls. [7 – Committee Member]

> …we've seen an explosion of activity in relation to defective building products, in particular, exploding glass balconies and cladding, cladding, cladding, both your aluminium composite type panelling and the expanded polystyrene cladding, in particular. Huge exponential growth in relation to claims in that area. [21 - Lawyer]

Managers raised concerns regarding defects associated with glass panels that often surround unit balconies. Glass panels dislodging from balustrades and subsequently shattering were identified as a major safety concern. The difficulties and costs associated with inspecting the defective panels was also explained:

> the other one that's becoming more common is glass. So either the glass panels are too big and they're deflecting too much or they've got too much nickel in it and they're exploding in heat and cold. Yeah. We're seeing that everywhere. [13- Manager]

> … there's a glass falling out issue. So when we pushed the builder to get a report independently and then the report revealed these nickel sulphite inclusion in the glass, which is causing the glass to fall out. But now in order to identify which glass contain those, you need to undertake a scan process and that's going to cost over a hundred thousand dollars, just to do that inspection. So builder is saying well we are not going to pay for that [20 – Manager].

4.2.3 To what extent does human error play in contributing to the building defects?

Many of the interviewees suggested human error plays a significant part in building defects. Misuse of building products (due to lack of knowledge), poor workmanship, time pressures (cutting corners), poor supervision, lack of training, lack of licensing and trade accountability were common factors identified as contributing to defective building work. The following quotes illustrate these observations:

> …three things that contributed to it were the type of building products the builder had used, poor workmanship, cutting corners by the builder and poor supervision [11 - Manager]

> …incomplete works, you know, we effectively classify this as defect and defects a lot of them are caused by poor workmanship or lack of care or, you know, we sort of look at stuff and go well that was done on a Friday afternoon. [12 - Developer]

> The materials will work if they're used in accordance with the specification but it's rare that the builder is sufficiently and technically able to have knowledge of how the product is supposed to be applied. I think what happens is their building is a complicated building and I think that the products have a scope of use beyond what it actually is and that's a problem. [5 - Lawyer]

> … this last year there's a 48% decrease in TAFE for apprentices so you've got no one coming through. The ones that are coming through aren't getting trained properly. So there's guys going straight out doing tests and they haven't got a clue what to do. I know three companies at the moment because of the staff I used to have in my old business are working for them and they've basically got a baseline to do 30-minute emergency light testing, it's supposed to be a 90-minute requirement. So it's money, it's pressure. And then on top of it is lack of skills and then poor licensing from the top end. [6 – Fire Engineer]

> As a developer there's no constraints at all on whether you can be a developer or not or how you go about doing it. As a builder, you have residential building licences run by Fair Trading. However, there's no – there's a licence class for being a builder. But once you've got that licence class to be a builder, you could be doing a small extension or you could be building a 20 storey building. There's no extra licence requirements for you… [2 - Lawyer]

One developer interviewee explained the quality of work is dependent on the qualification required for the trade, whether the work is required to be certified or 'signed off' upon completion and whether or not the work is performed by the qualified tradesperson.

> Well that's the interesting question because you have a large plumbing contract or a large electrical contractor or a painting contractor, there's no guarantee you've got tradesman doing your work for you. Electrical probably because someone's got to sign it off. Even mechanical, someone's going to sign it off. But trades like painting and tiling, even for your joinery and stuff, you don't necessarily have to be a tradesman you just go and put it in. Yeah, I think probably in terms of, you know, you could get into a big

> discussion there about why people work in construction and why people aren't doing trades anymore and you could talk forever. But the industry at the moment, that's where it is. Tiling, a lot of tilers are foreign workers. I don't know whether they're qualified but I assume they're being employed because they're cheap. [12 - Developer]

4.2.4 To what extent do exogenous factors play in contributing to building defects?

Two recurring observations were made by interviewees regarding organisational factors that contribute to building defects in residential multi-owned properties. The first was the motivation to make a profit (incentivising builders and trades to source cheaper building solutions), and secondly, time pressure completions that result in mismanaged construction processes (including uncoordinated time allocation of trades) and inferior buildings.

> The problems are the people doing the construction or giving instructions on the construction or deciding what products to use and stuff. Basically builders and developers. They're the ones who aren't responsible for anything that cuts corners, which at the same time increases their profits. So I think that's the problem. [2 - Lawyer]

> … developer is ultimately not the long-term owner of the property and therefore doesn't have that vested interest in making sure that this is going to be built properly. They just need to get it built and sold and out to make them money. That's what their focus is. That's the problem. It's the management of the risk whereas a developer of a commercial property has tremendous incentive to really deal with the risk properly whereas the developer of resi properties are whatever. [5 - Lawyer]

> Part of it might be design co-ordination, part of it might be just quality and supervision. But I mean, there's all the co-ordination, I mean we use design and construct and we rely on the builder to co-ordinate the design. But there might be how the electrics integrate with the mechanical, they might not have that overview covered properly. I mean, they should do but – and probably when you're doing design and construct, the builders, you provide them with a brief and they've got an incentive to find the cheapest solution. So you try and go in with a pretty strong brief but sometimes they might provide something that's not quite to the standard that's required. [12 - Developer]

> … waterproofing needs to follow a process that builders need to understand the process more, rather than thinking that they're just going to get a waterproofer in and they're just going to get a balustrade guy in and they're going to get a guy to put the doors in. Really the person who's overseeing it needs to understand all those principals and have one follow the other. [8 – Building Consultant]

4.2.5 Is the private certification system flawed?

Stakeholder and end-user views differed when discussing the role of private certifiers. There was a general consensus by end-users (i.e. committee members) and lawyers (representing end-users) that the system was deeply flawed. Committee members raised concerns regarding conflicted interests and fraudulent documents.

> **…** It's a little bit different when you're an individual putting in a pool, then council is all over it as far as fencing is concerned. But if you're putting up a multi-storey building, they don't want to know about it. I do know the relationship between the builder and the certifier is too close, shouldn't be like that. The certifier that certified this building, his address was the developer's builder's address. He had a company within the company. [7 – Committee Member]

> I provided them with evidence of falsified certification documents, Form 15s and 16s … they knew that it was signed off fraudulently and nobody wanted to take ownership because otherwise there is liability and that's just how it is. I mean the building in Australia is incredibly corrupt. It's incredibly corrupt. [1 – Committee Member]

Conflicted interests between the builder and a number of other professionals (fire engineers, certifiers etc) were a point of discussion in many of the interviews.

> I think there is a flavour around the industry, and this extends beyond fire, but fire in particular, of people issuing forms and things like that saying things are okay when they haven't actually inspected it themselves. Particularly when there is a relationship between the builder and the particular fire engineer who might have designed it, and the builder says to the fire engineer oh, I install all that. Can't you just take my word for it? And Mr Fire Engineer who wants to get the next gig says oh, okay, if you tell me that, you're honest, you're Honest Harry, I'll sign the Form 16 to say it was installed in accordance with my design. I think there's a flavour of that. [3 - Lawyer]

Lawyer interviewees were generally in agreement that the private certification system was flawed and pushed too far. They felt there was a disconnect between the certifier / surveyor's statutory role (i.e. their function under the relevant legislation) and community expectations (i.e. independent oversight of building quality and function). As one interviewee stated, "certifier is probably a misleading description that gives comfort to consumers." [2 - Lawyer]. Another lawyer interview recounted communication from a certifier regarding their role:

> It was explained to me once by a certifier in a legal letter back to us where they said that our role is to simply collate all of the product warranties and certificates from all of the installers, and once we feel we have sufficient documentation, we then rely on those documents and we issue the occupancy certificates from there. So they really are paper shufflers. [19 - Lawyer]

The following quotations illustrate the opinions of lawyer interviewees regarding private certification:

> I think the private certification model was pushed a bit too far, and I think there is a huge gulf between the regulatory oversight role that surveyors have in practise and what the community expects and thinks that role is, a massive, massive disconnect. I think in recent times, and you've seen the surveyors being hung, drawn and quartered for being responsible for all of this, but I must admit, I feel some sympathy for their position. If you look at their statutory function, under the relevant legislation, it's a very light touch regulatory model that involves three or four mandatory inspections over the life of the construction [21 - Lawyer]

> They're a flawed part of the system. There are different perspectives on the role they play. I see them as a problem. I don't see them as the main cause. Because it's not their role to check – certainly under the legislation, which is why they're not liable for anything most of the time. It's not their role to check everything and verify there are not defects. Except for a small number of inspections that are sample inspections that are required under the legislation, their role is to check that all the paperwork is there. [2 - Lawyer]

> I think that most consumers would be shocked to think their certifier is not standing over a waterproofing membrane on a roof and saying to the tradespeople, 'Okay, looks like you've completed that termination perfectly there, so I'll now allow you to put the concrete over the top, to now beat that down.' [19 - Lawyer]

As explained by some interviewees including a private certifier, it is not feasible to inspect every element of the building either before or after construction. The system appears to only work when a certifier / surveyor can rely on the competency of all the other professionals involved in the build. Responsibility, according to the certifier interviewee must be on all those involved in the building process.

> On a 16-20 storey building, how am I supposed to know with certainty what you've put on the outside of that building is what I approved? Sure certifier's responsible, builder should be responsible or doing the right thing, architect should be responsible, government should be responsible, the developer should be. Because I'm not onsite to do this they still need to be correct and I'm allowed to rely on a competent person to give me a certificate to say that they've constructed it in accordance with the relevant standards and codes. [16 – Private Certifier]

> …it would be impossible for any construction professional to come on unless you're on site or full time supervising the work, which is what the builder does. It's impossible to say that this is the defect, then nothing wrong with all of this. Or even if you were full time, you still couldn't say it because there's no one person who could say all the different – the hydraulics, the fire safety, the electrics, the normal building, the waterproofing. You need - Multiple - So no one person could do it afterwards. No one person could do it during the construction even if they were full time. [2 - Lawyer]

> …the way a private certifier's business will operate is he will deem somebody, or a certifier, will deem somebody to be a competent person then he can, under the Act, accept a form from that person and he can rely upon that, and he has an indemnity and a guarantee under the Act that he's entitled to rely on. In circumstances where [the private certifier] won't be an engineer, particularly a fire engineer, he's not going to be in a position to be able to go and do that inspection himself. He has to go and get somebody who is competent to do that. It makes sense. Where the system falls down I think is, that's at one point where it falls down, the certifier doesn't, they're not an expert. The second place it falls down is, and I tell this to my certifier clients, "Don't look. If you look and you find out that there's something wrong with that certificate there is an argument that you mightn't be able to rely upon that certificate. So best not look." And that's really where it does fall down because the certifier is really put in a position where he doesn't know what he's looking at in terms of that technical detail. He's got a certificate from somebody who does that says ya hoo, yippity, it's all good. Really it's in his interests to then just put that in the file and go, great, I've got that. [3 - Lawyer]

Certification System: Regulatory Note – At the time of writing, all referred governments had or were in the processing of undertaking reforms in this area.

New South Wales: The role of a private certifier is to issue construction certificates, carry out critical stage inspections (prior to waterproofing, covering stormwater drainage and prior to occupation), issue occupation certificates and issue compliance certificates. Conflict of interest provisions preclude a certifier from carrying out work if the certifier has a private interest (including a pecuniary interest) in respect to the work and the interest comes into conflict with the certifier's duty to act in the public interest.

Queensland: Currently, the role of a certifier includes carrying out building assessments, giving compliance certificates, inspecting building works (mandated only for class 1a and 10 building structures. Guidelines are provided for class 2 to 9 buildings), and giving certificates of classification. A licence is required to carry out these functions. There are additional provisions for the QFES to inspect special fire services. Conflicts of interest provisions preclude certifiers from acting in certain ways including if they have a pecuniary interest in the building.

Victoria: The role of private building surveyors is to issue building permits, carry out inspections, issue occupancy permits and serve building notices. The government has implemented reforms, which include: additional mandatory inspections (e.g. fire and smoke resisting elements), making a record of inspections, and ensuring a registered person carries out inspections. Conflict of interest provisions preclude a surveyor from acting in certain prescribed circumstances (e.g. if there is a pecuniary interest).

4.2.6 To what extent are those who are liable for building defects avoiding their responsibilities?

One of the main avoidance measures discussed by interviewees related to the creation of single purpose companies for new builds. It appears to have become a common practice for all types (small and large) of development and building companies to register a new (subsidiary) company for each new development. Upon completion of the project, all profits are distributed leaving the company with limited assets. As a result, an owners corporation (several years post-construction) may find it difficult, if not impossible, to commence proceedings in relation to building defects. Frustration sets in when owners corporations become aware the same builder and developer has moved onto a new development and avoided their legal responsibilities to rectify the building defects.

> … a higher and higher proportion are just two dollar companies. Both the builder and the developer. And from 10 years ago, I was seeing seminar papers from lawyers, which they were giving to other lawyers, but also the construction industry groups, telling rooms full of builders and developers you should have single purpose vehicles for your development. They've been set up so that they can walk away. I think that's the problem, the biggest problem that it is – well you can build through two dollar companies. [2 - Lawyer]

> While they might be big developers or big companies, they've created a purpose-built company vehicle and it may be very difficult to establish whether that has any assets, and it could go belly-up at any stage during the proceedings or after. So I have to caution my clients by saying that you may not see a dollar for this, and you might be spending good money with lawyers and experts and you won't see a dollar for that either, and you've still got to fix it. And that has had - that's very sobering advice to receive, to know that at any point in time, you're going to have the rug pulled up from under you. So I would like to see much stronger regulations come through. [19 – Lawyer]

An additional complication that arises (especially for owners corporations) in terms of responsibility revolves around shared liability. As discussed by many interviewees, a builder is often the initial respondent but will join a number of other building professionals in order to either share the liability or pass their liability onto others involved in the construction. As illustrated by a number of lawyer interviewees in particular, large defect matters can become very costly and time consuming. One lawyer interviewee divulged that he advises owners corporation clients to fix the defects without litigation if the total costs is $100,000 or less. [5 – Lawyer].

> They are trying to share their liability with other parties, such as the building surveyor, the fire engineer and the architect and also the person who initiated the fire, et cetera, et cetera. So there are so many parties involved but at the same time as you can see everyone is trying to pass on their liability. [20 - Manager]

> Some are quite complex where you're dealing with large apartment towers and you might have, potentially, hundreds of applicants; you'll have the overseeing individual owners as parties and in addition the usual respondents or the usual defendants and generally the primary target being the builder. The builder will often bring in a variety of other consultants involved in the design and construction process: there might be subcontractors, engineers, architects, building surveyors. You do spend a lot of time chewed up in joinder applications and then, once somebody has joined, they need to go through all the motions and the interlocutory steps before you can sit down and talk about the issues…a lot of these sorts of cases are very heavily dependent on expert evidence which is very expensive and time consuming to attain in terms of liability, so what is actually happened, what has gone wrong, who's responsible. Then trying to cost out how that's going to be fixed, and with a cast of thousands trying to figure out [21 – Lawyer]

4.2.7 What are the impacts on committees and residents dealing / living with defects?

Interviewees raised concerns about the health impacts building defects have on residents and committee members who often need to make decisions regarding remedial works and litigation (if any). From a physical health perspective, the impact of mould (as a result of water ingress) was undoubtedly the most discussed concern. The various psychological impacts (particularly stress) on committee members dealing with building defects was raised by many interviewees. Financial pressures, the devaluation of properties, protracted rectification processes, and the practices employed by developers to stifle rectification were also highlighted as factors impacting committees and residents.

In relation to the physical health impacts, one interviewee commented that the health concerns relating to mould are reminiscent of concerns raised regarding asbestos. Others were concerned that residents continued to live in apartments infected by mould.

> People are very distressed. If you can't live in your apartment and some of those buildings are like that. You can't live in there because there's mushrooms growing out of carpet or there are so many spores in the air that you can get respiratory diseases. You do hear people get into serious trouble because they got to sell the place but they can't sell it because it's worth nothing. [5 - Lawyer]

> There was mould growing in all of the apartments, I mean some people were living there, but it was basically uninhabitable…the owners were deeply distressed, they'd paid a lot of money. [4 - Lawyer]

One interviewee explained that the builders who were engaged to treat mould-affected areas often did not understand the nature of mould, the spread of spores, or the (long-term) health impacts. This interviewee recounted numerous examples where tradesmen failed to implement control measures in an affected area in order to minimise the spread of mould spores.

> The mould rectification practices are ineffective and lead to further spread of mould through the living environment [14 – Building Consultant]

Although fire is perhaps the greatest immediate risk to life and many building defects were reported as fire related, some interviewees reported that owners corporations are often slow to rectify fire safety defects. As one interviewee commented, 'It's Murphy's Law, people just don't think it's going to happen.' [6 – Building Consultant]

In a building where a fire started, residents did remain nervous after the event. As the manager of a building where a fire broke out reported:

> … every time they [residents] say there's a fire engine going around the area they think it's a fire in the building. They do have to live with that fear. In fact one committee member said he has got a bag ready. [20 – Manager]

Other potential health and life-threatening situations raised by interviewees related to sewage and exploding glass.

> Sewage is problematic because that stuff when it ferments and the gases and all the rest of it they become explosive so it's a real risk. Those things are unusual but they do come up from time to time. [5 -Lawyer]

> … it's just a matter of time that someone will be hit by the exploding glass if they haven't already. I always find it amazing that people are like, "No one was there," and it's like, how can so much glass be exploding, and no one be there? It would be interesting to see how much attention is going to be given to that if someone is actually hit [21 - Lawyer]

From a psychological perspective, many committee members, managers and lawyers discussed the impacts of dealing with building defects. Stress was the word constantly used to describe the emotional toll of dealing with substantial defects in particular. Committee members interviewed reported they had restless sleeping patterns, cried, and felt emotional drained. The time it takes to get a resolution, unfair tactics by builders and developers, the decision-making process, the anger from other lot owners and residents, and for many, living in a defective building were all contributors to the stress. The following quotations illustrate the stress committee members often face:

> The psychological health is - particularly on committee members when you're in a long term court case - if you're in the Supreme Court and you're talking millions of dollars, is awful to watch. And you're trying to be their advocate and you can see what the other side's doing. They're deliberately fatiguing. You've got 10,000 directions hearings and you're going how are we possibly in another directions hearing. Like what? And they'll always do a court step offer at the last minute. The owners corporation can't even approve that. They're physically not able to call a meeting and approve it. So it's just these unfair tactics that you definitely see exhausting people. [13 - Manager]

> Psychological and health impacts, it is tiring when you've got your normal everyday life, whether you work full-time or whether you're a caregiver or whether you're retired. But it's not healthy or sustainable over a 12-month, 18-month, two-year, let alone three- or four-year period to be in almost daily, weekly contact with your lawyer about things managing these very complex claims. Usually it does fall to the committee to manage these claims. [19 - Lawyer]

> I feel sorry for that other lady because she's a very nice lady and I actually asked her to come on the committee and this was before it became difficult and complicated and now we've got this whole guilt thing that I have brought her onto the committee and then she stresses out severely, right? And, you know, we've become friends and I say you know, we've got to do what we've got to do, don't worry about it, you know. But she, you know, usually I can go to bed and I can go to sleep, she can't, and I feel really bad about that. [9 – Committee member]

> She was on the committee for quite a long time, probably almost since the building was here, she had to resign because she was so stressed by it all. Stressed by dealing with the manager who was so uncooperative that she was bashing her head against a brick wall. [19 – Committee member]

> …the owners were deeply distressed, they'd paid a lot of money. It was marketed as a high end building and they were left with multimillions of dollars' worth of repairs to make it habitable. [4 - Lawyer]

> …my husband cries every night. [17 – Committee member]

> And what really got me motivated to get involved if you're after it, was the young fellow below me was like a first home buyer and he came up and he was crying in my living room and he just said, "Look mate, I can't afford to go broke, I'm 21 years old." [1 - Committee member]

> I'm quite good at coping with that stuff, it usually doesn't worry me, but a couple of weeks ago even I found it like this is just too hard and, you know, but the thing is I don't want to walk away. I just sat on the couch, it's like I've had enough, you know. [9 – Committee member]

The financial impact of dealing with defects was also a stress contributor. Interviewees commented that lot owners are often unaware that insurance (in many instances) will not cover the costs associated with rectifying building defects.

> Well the clients are really uneducated. They think they still have insurance. So often, they think they've got seven years of warranty and they have insurance. So when you tell them, well in reality, you don't have insurance - there's a genuine initial shock that you've got to work through. I'm finding they're not that educated. They're more - yeah, they go in there with this feeling that there's protection somewhere. That someone is protecting them. They've got no concept that it's just not the case. [13 - Manager]

If the defects are not rectified in a timely manner by the builder, or the builder and developer companies have been liquidated or wound up, and the owners corporation needs to commence remedial work, then additional financial pressure is borne by the lot owners. For some lot owners, the additional financial burden forces them to sell (if they can and usually at a significantly reduced price) or borrow additional monies. For some investors, either rents had to be reduced or they were unable to obtain a renter. A number of interviewees reported that lot owners have been forced into bankruptcy as a result of additional special levies that they simply could not pay.

> There were other people who were on the verge of bankruptcy there. [1- Committee Member]

> It's harder to manage those buildings out in the west that have defects on - I don't mean to say it, but that really is the lower socioeconomic buildings. Because the owners, they've literally mortgaged themselves to the absolute hilt. It's their first homes. They don't have the extra money to fix the buildings or to pay for legal fees. Another mortgage isn't an option for them. So they're just looking at you saying, why are you doing this to me? [13 – Manager]

> There have been people who have lost their units and that's been awful, it's been awful to have to see. They just can't afford it - They've had to move on. We've had to go through the debt collection stage and you can see they're struggling and it's not a nice thing to go through [17 – Committee Member]

> They bought in for about maybe four hundred thousand plus. Some people bought off the plan in 2012 and I spoke to an owner in particular and she lived, it was an investment apartment for her and she lived in South Australia. She couldn't get the money she paid, I mean five years ago and she was in tears because she

couldn't even pay off the mortgage. Well some people had tenants and they weren't able to find tenants again, you know rectification works took over a year and a half and for various reasons that was put on hold and then yeah. But then after that they weren't able to get the same amount they had previously. [20 - Manager]

One committee member who was involved in a building with significant defects discussed the owners corporation options regarding funding the defect rectifications. The committee considered a loan from a financial institution but ultimately decided the best course of action was raising special levies. The decision to self-fund over a loan was based on personal liability concerns.

…we went into that we realised that the lender doesn't have security over the property and there's personal liability on all owners to pay, and some of us thought we might be left with the baby. It was a real thing, and that was a bit of a learning experience too [17 – Committee Member]

Obligations to Repair and Maintain: Regulatory Note – owners corporations generally have an obligation to repair and maintain common property. Although, it is arguable these statutory obligations only obligate an owners corporation to rectify defects that are reparable. In the event a defect is unable to be repaired (for example, remedial works require removal and re-installation of an element to rectify the defect - membrane) then these specific obligations maybe redundant.

New South Wales: Owners corporations are required to maintain and repair the common property. However, the owners corporation can defer compliance in the event that action has been taken against a responsible party if the deferment does not affect the safety of the building or common property. If the owners corporation fails in their duty to repair and maintain the property, an affected owner may recover, as damages, any loss suffered. There are prescriptive provisions relating to building defects in the Strata Schemes Management Act 2015 (Section 189 to 215) including requirements relating to inspection reports and building bonds.

Queensland: Bodies corporate must maintain common property. For schemes created under building format plans, the body corporate is required to maintain railing, parapets and balustrades on the common property boundaries, doors, windows and fittings situated on common property boundaries, roofing membranes that are not common property but provide protection for lots or common property, foundation structures, roofing structures and essential supporting framework.

Victoria: Owners corporations must repair and maintain the common property and related services, chattels, fixtures and fittings.

4.2.8 Interviewee recommendations for change

4.2.8.1 Strengthening the Private Certification System

There was general consensus by interviewees that changes were required to the private certification system. Mandatory inspections of fire separation and waterproofing measures were two specific recommendations made. Regulatory changes regarding the function of private certifiers were also recommended in order to ensure better verification checks were made to the quality of construction. Changes to minimise the harmful effects of conflicts of interest were also recognised as well as a central repository to store all records relating to the construction of a building including documents collated by private certifiers.

One of the inspections that should be mandatory for me is at fire separation stage. Get me out there, and when they do get me out there and knock it back because it's not done right. So it gives me an indication of the level of competence or education that the competent people are building to. [16 – Private Certifier]

> The PC (private certifier) needs to check as substrate level – that is they can advise the proposed membrane, primer and installation program. The PC doesn't need to be a specialist expert, but expert enough. [14 – Building Consultant]

> I would have thought there needs to be an amendment of the regulatory framework so that surveyors are more actively and forensically involved in checking things and verifying things particularly around some of the core safety aspects of a building and a building's performance. [21 - Lawyer]

> But in an ideal world, the number one thing that I would like to see is a strong and very robust certification system, because - and as long as there's that conflict of interest with the certifier being paid by the developer or builder to sign off on things, they're never going to get any repeat business from that builder or developer if they don't sign off on what's there. [3 - Lawyer]

> By virtue of the private certification system and council, at least, having that document repository role, that at the various key stages, issuing a building permit, occupancy permit, etcetera, etcetera, the relevant paperwork must be filed with council with all the documents. That system is a bit hit and miss and that could be dramatically improved. For the life of me I don't understand why there isn't some kind of electronic repository where it's logged and maintained because all the councils have slightly different idiosyncratic approaches to how they store these records and sometimes they get lost, it's just a bit of a convoluted mess. [21 - Lawyer]

4.2.8.2 Extending the Statutory Warranty Insurance

The lawyer interviewees in particular recommended extending the statutory warranty insurance scheme to cover buildings over three storeys. Many were perplexed about the current regime and believed that building defects would not be as prevalent if the insurance scheme were extended to cover buildings over three storeys.

> If it's less than a four storey building, and a job over $20,000, you need to satisfy the home warranty insurer that you've got the capability and solvency for it not being an unacceptable risk. So if you're going to build something in that window, it's a lot harder for you to actually be allowed to do it, because you've got to persuade the insurer that you're capable and good for it. So it's not a licence issue but it's effectively – adds an extra licensing requirement before you can do the work. But you don't even have that. So if an insurer won't give you – doesn't trust you enough to give you insurance to do a $25,000 job, just go and build a high-rise and you're fine. [2 - Lawyer]

> Obviously with domestic building work over three storeys they're not required to have insurance, which I still find staggering, but that's often a very big issue to figure out what you're dealing with early on. Insurance is a huge, huge factor in terms of whether things are going to settle or not settle and how. I think the better course would be to extend the statutory warranty scheme to not exclude buildings three storeys and above. [21 - Lawyer]

> In France they have this d cennale insurance. It's a 10-year long stop insurance so people are on the hook for building defects for a long time. So if you prevent the developer from transferring that risk on to the lot owners and have him buy 10-year insurance which is going to be expensive, the incentive on reducing claims and all the rest of it is going to be there so they make sure things are built properly to start with. I don't think more regulation is necessarily the thing that's going to cure it. You need to change the commercial imperatives of how things are done so that there's a commercial imperative to doing it properly because commercial buildings seem to be built well. [5 - Lawyer]

4.2.8.3 Changes to the Australian Standards

As noted above, concerns have been raised regarding access to Australian Standards and the lack of guidance in relation to remedial works. Interviewees suggested changes to the standards that incorporate these concerns, including more practical guidance, a registration of approved products (including membranes) and databases that compare products.

> The Australian Standards Committee is too technical and bureaucratic, not practical or realistic with hands on experience. A systems approach is required to update the Aus Standards, plus a registry of proven membranes, to improve accountability of suppliers and manufacturers. I would like to see standard product datasheets set by the Australian Standard, so you compare across products as all the information is predetermined by the standards and set out the same. This would be applicable across all the standards. [14 – Building Consultant]

4.2.8.4 Increased engagement with Industry

As threats continue to emerge regarding building defects, many interviewees were annoyed by the lack of collaboration with industry experts.

> I think the regulators need to engage more with the stakeholders in industry, insurers, practitioners. At the moment there's very much a them and us mentality in the regulators, which I think is really unhelpful, and I think they're just not doing enough to consult with insurers about these sorts of issues and I think they have a lot of very valuable input and expertise around these sorts of issues that they could be drawing on if they just bothered to ask. [21 - Lawyer]

In relation to recent reforms in New South Wales, many interviewees were concerned about the abrogation of rights in relation to commencing legal action against builder for defects.

> I've got nothing but absolute fury to direct at the policymakers in New South Wales about reducing the time limitation periods for claims right down to a very high bar and with this new bond system that is now live and operating for these newer buildings that are being constructed now. That is a removal of several legal rights to bring a claim by constraining the ability of the owners corporation to have control over the defects that they may find within their own buildings by having it is a developer-led process. In New South Wales, it should be to learn a lesson from what's happening in other states and territories, particularly Victoria, about the 10-year time period, and reintroduce that. That's wishful thinking. That will never happen, ever. But it's a great system down there in Victoria. For Victoria, my message to regulators is don't touch what isn't broken. Don't mess with this. Don't touch it, it's a system that has foibles and has limitations, but 10 years is a good period of time to bring a claim for building defects, and it shouldn't be wound back. [3 - Lawyer]

> …part of the problem with building defects litigation in NSW is the process, how long it takes, how much money it costs, and how that becomes an attrition and survival process for owners, strata plans, as much as single dwelling owners who are on their own. You just need to simplify it so - I always encourage strata plans to set up so they pass the approvals they need at a general meeting initially, maybe to commence proceedings, but also to delegate. To set up a procedure where decisions, moving forward, can effectively be done in real time, without having to wait two weeks for a general meeting. [2 - Lawyer]

4.2.8.5 Education for Strata Managers

Although more education for all those involved in construction and rectification processes was discussed, many interviewees (both committee members and managers) recommended more guidance for managers and committees dealing with building defects.

> So as an industry, education in general is lacking. There is no barrier of entry to be a strata manager. I know they're changing the licensing a little bit. It's still not difficult. So you've got these people with huge responsibilities and no idea what they're doing, or perhaps even of the scope of the responsibility that they've got. Which is why those deadlines are going to be missed. And I'm sure there are so many two year proceedings that haven't been commenced because they just didn't know. They're sitting there thinking, I've got six years, not knowing that that definition has changed, that there's no precedent on that definition. [13 - Manager]

5 Discussion and Conclusion

Four broad aims underpinned this research project: to identify the types of defects impacting residential buildings, to understand these impacts, to assess these defects against the Australian regulatory environment and to understand how defects are managed (by owners corporations and managers) and rectified.

5.1 Identifying the Types of Defects Impacting Residential Buildings

The building defects audit reports provided by various consulting companies allowed for an analysis of 3227 (line item) building defects. With little guidance from the existing literature, a building defects classification model was developed to organise and standardise the data in preparation for analysis. A classification model that identified the defects based on the effected construction systems was created. Thirteen construction systems were identified as relevant to most residential multi-owned properties – access and egress, building fabric and cladding, electrical, lighting and data, fire protection, hydraulics, in motion equipment, mechanical and ventilation, roof and rainwater disposal, safety, structural, utility supply, waterproofing and non-essential services (pools etc). Sub-categories were created that aligned with each of these construction systems in order to identify the individual construction element inflicted by the defects. For example, 19 sub-categories were created for the construction system ‘building fabric and cladding’. Effected elements included: lightweight cladding, masonry, joinery, plaster and render, stairs, windows and doors, sanitary fixtures, non-structural slab and vermin proofing. Some elements were further categorised. For example, masonry was further categorised as brickwork, efflorescence, horizontal control joints, tilt panels and vertical articulation. The developed classification model provided an essential template to organise the disparate data provided in the various audit reports.

From the information provided in the audit reports identifying building defects, the most impacted construction systems were (in order): building fabric and cladding (40%), fire protection (13%), waterproofing (11.5%), roof and rainwater disposal (8.5%) and structural (7%).

For building - fabric and cladding, lightweight cladding (collectively) and masonry elements were the most impacted by defects. The most common defects noted in the reports were: for lightweight cladding – cracking to plasterboard, flashings not installed / or not installed to standard, water damage and mould to plasterboard, corrosion of soffit fittings, soffit incomplete, efflorescence and rust to soffit. For masonry – delamination or incorrect installation of render system, weep holes covered, efflorescence to brickwork and roofing slab, lack of or cracking at control joints were the most impacted by defects.

For fire protection, most defects related to the passive fire system. Examples of defects included: missing fire collars, missing or incomplete fire separation at penetration, incorrect size of fire collars, damaged fire rated walls, compromised fire barrier, lack of appropriate fire separation between units, incorrect materials used for fire barrier.

For roof and rainwater construction system, the most recurring defects related to roof cladding, gutters and concrete roof. Examples included: inadequate grade to drains on roof slab, membrane failure / defective installation, water ingress around service penetrations, missing membrane to roof parapet, box gutter overflow provisions lacking, inadequate fall to box gutter, leaking roof gutter, defective installation of roof sheeting, and incorrect installation of flashings.

The slab and foundations were the most effected elements in the structural construction system. Examples of defects included: cracking of structural slab, inadequate grading of floors, concrete spalling, excessive movement of slab, inadequate hob to balconies, lack of isolation joints, exposed reinforcement to slab, subsidence, retaining wall failures.

Membrane failures (specifically balcony and internal wet areas) were the main defects for the waterproofing system. Examples of these defects included: lack of applied membrane, lack of membrane upturn / termination, defective installation of membrane. Paint related defects were also common including blistering paintwork, incomplete paintwork and delamination.

Less prevalent were defects related to the following construction systems: hydraulics; safety; electrical, lighting and data; mechanical and ventilation; access and egress; non-essential; in motion equipment; and utility supply. In any analysis of building defects, it is important to consider the systems and elements that infrequently result in defects. Although not explored in this study, an examination of the trade qualifications, licensing or registration and regulatory requirements imposed on these trades and for these construction systems would provide insight as to why there are minimal defects impacting these systems.

It is important to note the identified defects (as reported) may have been either originating (isolated), resulting and / or part of multiple interrelated failures. That is, the reported defects can be isolated and originating from one element. For example, a waterproofing membrane failure is a defect originating from the membrane element (therefore isolated and originating). However, the membrane failure may result in water ingress that affects other construction system elements (for example, lightweight wall cladding). The water ingress weakens the structure of the wall cladding creating a further defect (the resulting defect). The water ingress from the failed membrane may contribute to multiple other element defects and therefore all effected defects become interrelated. It was difficult to determine from the audit data whether or not the specific defects were originating, resulting or part of an interrelated group of defects. However, there are positive relationships between different construction system defects. That is, there are positive correlations between waterproofing and building fabric and cladding defects; waterproofing and structural defects; waterproofing and roof and rainwater defects. Furthermore, the data analysis provided evidence that on average a building has defects that are located in six separate construction systems.

Further information and analysis is required to determine the causal links between the identified defects. The high proportion of defects that are a consequence of water ingress (over 30%) leads to an assumption the root cause of at least 30% of building fabric and cladding defects is a result of waterproofing or roof and rainwater disposal failures. It is arguable that water ingress related defects are more insidious in a building than the construction systems based analysis provides in the results section of this report. This conclusion aligns with the comments made by various interviewees, that water ingress is a major contributor to building defects.

A further factor that impedes the identification of building defects is latency effects. Aside from the originating and resulting categorisation, defects may be patent (i.e. obvious upon an inspection) or latent (i.e. concealed or revealed in time). Water ingress related defects for example, may manifest early in the lifecycle of a building and are obvious upon inspection. A number of interviewees advised that water ingress related defects often manifest after the first major rain event impacts the building. Water leaks in particular are observable to residents and usually require more immediate action. However, there are concealed defects (usually behind a wall or other structures) that only manifest or are observed in the event of an independent action (for example, a fire, ground movement or exposing the concealment). It is often difficult or even impossible to detect such defects when undertaking a building audit post-construction. Often the removal of a construction element or part thereof is required to identify the defect. A number of interviewees commented that fire separation in particular is one such defect that is often overlooked due to concealment. The building consultants interviewed for this project advised that latent defects, particularly fire related defects, are often uncovered by accident when rectifying other building defects. Although passive fire defects were the most prevalent defects reported under the fire protection system, the majority of those defects related to penetration seals, which are easier to detect than fire separation defects. Given the comments made by a number of interviewees, it is likely there is a higher proportion of passive fire defects than identified in this report. The concealment of fire separation may also be the reason that past studies have not accurately identified fire protection defects as a considerable problem. Undoubtedly, hidden defective work, especially fire protection related defects, is a serious issue in need of further investigation and regulatory intervention.

Although these results differ from those of the noted Spanish defects studies (outlined in the literature review), they do align, to some extent, with previous defects studies undertaken in Australia. Those studies identified a high proportion of water ingress / moisture related defects but did not find a high proportion of fire protection related defects. These differences may be due to the type of data analysed and the latency effects of fire protection defects.

5.2 Understanding the Impacts that Defects have on Buildings and Occupants

Buildings and occupants of buildings are impacted in a number of ways by defects. The results of the building reports analysis identified that defects can cause multiple impacts to a building including: general damage, water related damage, or can make buildings unsafe. As a result, occupants may be impacted due to: the effects of water ingress (including damage to personal belongings and mould) and living in and around unsafe environments. For lot owners, there are often financial impacts (including raised levies to fund rectification works, loss of rent, and property value depreciation). Furthermore, owners corporation committee members are often left to make complex decisions on behalf of other lot owners in the event builders avoid their responsibilities in rectifying building defects. The complex nature of dealing with significant defects can result in psychological health concerns (e.g. stress) for committee members. Making decisions regarding legal advice, litigation, rectification, financing remedial works and so forth is a time consuming and stressful endeavour for volunteer committee members. Building lot owners and residents in new buildings should, in an effective regulatory and construction environment, be confident the building is fit for purpose, is safe, and won't require additional funds to make right.

The most concerning aspects revealed in this research project relating to impact are:

- The number of defects present in buildings is significant (there is a problem);
- The number of defects relating to fire safety is alarming. Fire is a direct threat to life and fire safety measures installed need to be independently checked and verified to ensure compliance;
- Mould that has arisen due to water ingress defects is often present and has the potential to lead to serious health implications for residents. The lack of care by trades in properly managing mould often leads to spores embedding or remaining in lots;
- The type of defects commonly observed require invasive and often costly remedial works to rectify (particularly waterproofing and fire separation failures);
- The financial burden placed on lot owners when builders fail to rectify building defects can lead to a number of psychological health impacts (particularly stress related) and for some, are financial ruining;
- The strain and time commitment required by committee members, when acting on behalf of the owners corporation, in order to remedy defective buildings is clearly evident and concerning from a health perspective.

5.3 Assessing the Regulatory Environment

Many interviewees raised concerns about a number of aspects relating to the regulatory environment that oversees building construction. The minimum Performance Requirements outlined under the NCC, for many, don't reflect best practice and should. This view was expressed with frustration by those rectifying waterproofing defects. Experts in waterproofing collectively recommend that: the Australian Standards relating to wet areas be reviewed and amended to reflect best practice; trade training needs to increase and should include waterproofing as a mandatory module; the NCC include a deemed to satisfy provision the industry can effectively rely on; a systems approach be established identifying suitable membranes for different substrates, and a membrane register established that lists membranes that have been independently tested. Further guidance is also required for those rectifying membranes. Standards need to be developed to ensure remedial works undertaken are in accordance with best practice.

The private certification system for most interviewees is flawed and requires reform. Either the statutory functions of certifiers need to be better explained (perhaps a re-think of the job title) or they need to be changed to reflect community expectations (including extending site inspection requirements). In relation to conflicts of interest, the provisions outlined in respective state regulations need to be reviewed. Prohibiting conflicting interests that only arise within the subject development ignores problems associated with long-term future relationships. Continued future work can incentivise unethical practices. Although many jurisdictions have implemented or are considering legal reform in this area, it is recommended more industry consultation is undertaken.

Regulatory guidance should be considered for owners corporations dealing with building defects. Although New South Wales has incorporated new provisions specifically relating to building defects, many interviewees still had concerns about these provisions particularly the new statutory time limitations and the defects bond. For other jurisdictions, clarity should be provided to owners corporations regarding obligations to remedy defects.

Licensing is another key area that requires regulatory attention. Although not explored thoroughly in this research project, there are gaps in licensing, particularly in relation to some trades that needs reviewing. Multi-owned properties are a more complex building structure. Those working on the construction of such buildings should have specific qualifications and be licensed.

Insurance was another area many interviewees believe requires regulatory reform. Although insurers were not interviewed for this research project, it is important to investigate whether the statutory warranty scheme can be extended to buildings over three storeys and the potential implications if the scheme was extended, particularly on reducing building defects. Many interviewees suggested this is a critical issue that requires investigating.

However, given the current environment and the extent of building defects identified, it is unlikely that insurers would expose themselves to such risk by extending the scheme. Historically, this type of approach has not been successful yielding little financial benefit for the insurance industry.

As highlighted by Barbaro and Marfella (in the literature section of this report), the construction of high-rise buildings is more complex than other building types. Trying to fit and modify an existing all-encompassing construction code to various building products (including different classes) may be contributing to the problems associated with building defects. A further investigation into a national two-tiered system should be considered in order to ensure best practices (even if more prescriptive regulatory provisions are required) are observed and implemented for high-rise buildings. The patchwork method to regulatory reform observed by many interviewees is a contributor to the proliferation of building defects in Australia.

5.4 Understanding how Defects are Managed and Rectified

In new buildings, lot owners, their owners corporation (committee) and scheme manager are often placed in the position of dealing with building defects. There were mixed comments made by interviewees regarding the effectiveness of scheme managers when a building is faced with defects. The conflicted relationship with developers appears to be a continued sore point for committee members. Members often feel that scheme managers (who have pre-existing relationships with the developer) do not act in the best interests of the owners corporation when defects arise. The lack of pressure on the developer to hand over all scheme (particularly construction-based) documents exacerbates the situation and is problematic when rectification works are required. Some interviewees were well guided by their managers. However, a number of managers commented that more education and guidance was required in order for managers to effectively assist in dealing with defect matters. The defect rectification process is complex requiring a higher level of skill to effectively manage the process on behalf of or in conjunction with an owners corporation. Lacking in the strata industry is an education program and guidelines that assist managers in this process. Similarly, external consultants often do not understand the decision-making processes that need to be employed by owners corporations when managing building defects. A more co-ordinated approach is required to effectively manage this process. Construction lawyers and peak industry building consultants (particularly fire engineers, construction engineers and waterproof specialists) should be invited to assist the industry in formulating guidelines for managers and external consultants.

Building consultant interviewees commented that defects are often found after remedial works begin which in turn, can result in changes to the scope of works and therefore costs. Committee members and lot owners become frustrated as the costs and the time to rectify increases. Although not investigated in this research project, it would be advantageous to examine the initial identified defects (as reported) and the scope of works ultimately required to rectify a building with defects. Information of this type, would greatly assist in the management of the rectification process.

5.5 Concluding remarks

In examining the nature of building defects in multi-owned properties, this pilot research project has: developed a classification system for identifying defect; identified the most prevalent construction systems (and sub-categories) impacted by defects; and identified the main contributors to and consequences of defects. The project has also discussed the experiences of stakeholders and end-users involved in managing, advising on and rectifying defects. The impacts defects have on residential buildings, residents, lot owners and owners corporation committee members were also discussed. It is evident building defects are proliferating and cause great distress and potential harm (both physical and psychological) to those closely involved with these buildings. Government intervention that starts with in-depth stakeholder and end-user consultation is urgently required in order to stem the flow of these defects.

6 Research Limitation

This research study is not without limitations. As acknowledged in the methodology section of this report, this study is a pilot project and exploratory in nature. The research team was constrained by funding, data and time and it cautions extrapolation of results. The primary methodology relied on interpreting building audit reports from a number of companies across jurisdictions. The reports were not standardised, very few reports outlined the methods utilised when undertaking the inspections (ie. the process), and the qualifications and expertise of the inspectors were not detailed on the individual reports. It was difficult to determine whether the defects were only observational or whether preliminary investigative work was undertaken to identify the defects. As a result, the research team is not confident that latent defects have been incorporated into these reports. This is particularly relevant in relation to the fire protection system.

A further difficulty related to the interpretation of a defect. Some auditors may have been guided by the relevant statutory definitions applicable in their respective jurisdictions and therefore may have focused on major element defects more than other auditors. For the purpose of the analysis, Watt's definition of a defect provided guidance: a failing or shortcoming in the function, performance, statutory or user requirements of a building, and might manifest itself within any construction system.

As discussed in the report, the sub-categories were developed based on the 13 construction systems. They were identified based on the reported defects from the sample. We acknowledge these sub-categories are limited by the sample and anticipate they could be expanded in a larger project.

7 Future Direction

There are considerable opportunities for further research in this area. Such opportunities could include:

1. Expanding the current research study by analysing data from other building audit companies;
2. Expanding the current research study to other Australian jurisdictions;
3. Incorporating additional building information in order to measure correlation effects (such information could include: building height, classification, location, builder, developer, certifier, building timeframes etc);
4. Reviewing and extending the classification system outlined in this research. A system that includes severity determinants under each system would be an improvement;
5. Incorporating alternate data sources;
6. Reviewing building rectification reports (including cost estimate reports);
7. Evaluating the risks posed by building defects (risk matrix);
8. Focusing on building maintenance. As acknowledged by Jingmond and Agren, "…the impact of defects not only covers quality at handover, but has implications throughout the lifecycle of a building".[84]

[84] Monika Jingmond and Robert Agren (n 16).