UPCYCLING AUSTRALIA'S OLDER APARTMENT BUILDINGS

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ABSTRACT

The brick and concrete apartment buildings constructed during the economic booms of the late 1960s and early 1970s are reaching the end of their service life and are facing an uncertain future. These buildings have had minimal maintenance and care for much of their lives and substantial parts of their envelopes, interior fittings and services are deteriorating and potentially becoming dangerous.

The typical approach to many older buildings is to demolish them and replace them with new ones. An alternative approach would be to repair and retrofit them, extending their life as long as possible. This upcycling approach will retain the embodied energy in their masonry structures, and delay the emissions and waste of new construction. Repair or replacement of their envelope, services and internal fittings also brings the opportunity to improve the safety and security of these buildings as well as to improve energy efficiency and human comfort, to reduce water use and to retain a sense of history in the built environment.

This paper primarily examines the design and construction practices that must be developed to successfully maintain and retrofit the large numbers of existing apartment buildings as well as the policies and incentives that both motivate and frustrate this work. The flow of waste products from the upcycling and the eventual demolition and recovery of materials from these buildings is also briefly addressed, as is the potential reduction in energy and water use from envelope and services replacements

Key Words: Apartment buildings, Building maintenance, Retrofit, Building Service Life

1. INTRODUCTION

It is commonly stated that the built environment uses around 40% of the world's resources (Cheshire, 2016, p1), creates a third of global greenhouse gas emissions (Mardiana and Riffat, 2015) and the waste from its demolition and construction represents the single largest waste stream in many individual countries (Cheshire, 2016, p1).

Within Australia, awareness of these issues has led to mandatory energy efficiency regulations, Greenstar targets for the reduction of construction waste and the experimental use of lower embodied energy, low waste construction products such as cross laminated timber and fly ash concrete. Yet even if we were to build each of Australia's annual 140,000 new dwellings to the highest possible energy efficiency standards with the ability to generate enough renewable energy on site to completely account for the energy used in their materials, construction and occupation over their entire lifetimes, they would only make a very small dent in the emissions and waste stream of the building stock as a whole (Swan and Brown, 2013, p1). The energy use and waste from occupying the 9.7 million already existing homes vastly outweighs the impact of improving new construction (Lehmann, 2013, p63).

This is the reason why the very first Circular Economy principle for the built environment listed in ‘Building Revolutions: applying the circular economy to the built environment’ is to retain existing buildings – it is almost always the single most resource effective option. In most cases it is easier and less resource intensive to maintain an existing building and upgrade it to use less energy than it is to demolish it and replace it with an entirely new building (Cheshire, 2016, p32).

If we are to seriously consider the retention and retrofit of Australia’s buildings then some idea of their age and likely condition is required. Buildings in Australia are generally designed for a service life of 40-60 years; this is the time that buildings will perform as intended with minimal on going maintenance. (Standards Australia, 2009, p50). At this end of the service life period buildings do not necessarily become dangerous, unsafe or decrepit, but they do require an increased levels of maintenance and potentially the repair and the replacement of significant building components if they are to remain useable (British Standards Institution, 2011, pp4-6).

Without prompt care and attention, maintenance problems become increasingly onerous and expensive to fix until the cost of repairs threatens the overall value of the building. Buildings typically reach this ‘end of economic life’ at 70-80 years of age, (Bullen and Love, 2011, pp32-34) but with appropriate but with care and attention they can conceivably last much longer (Langston, 2011, pp423-425).

Figure 1 overlays typical stages of service and physical life with the age of Australia’s dwellings. It shows that 45% of dwellings are well inside their service life and are probably in good condition while less than 25% are well beyond it. Many of these older buildings will have already received substantial renovations or refurbishment, but those that have not are likely to be in a very poor state.

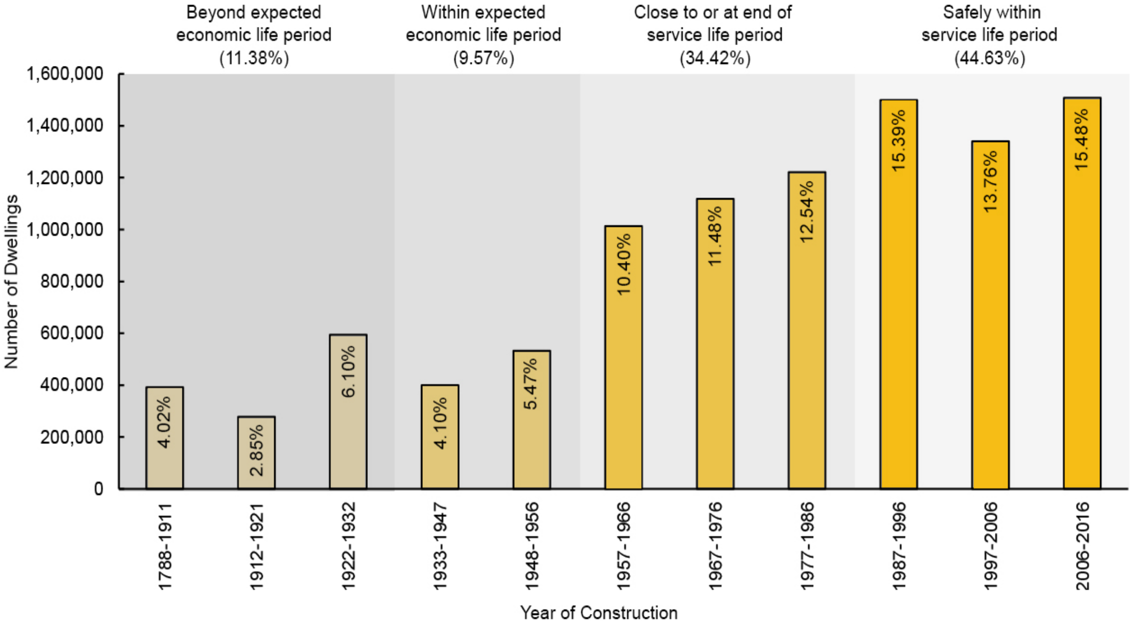

FIGURE 3: STAGE OF LIFE OF AUSTRALIAN DWELLINGS[1]

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[1] Generated 29 August 2017 using data provided by the Australian Bureau of Statistics from the Census of Population and Housing 1911- 2016

This leaves nearly 35% of Australia's dwellings either at their end of service life or close to that point. Unlike older buildings which may already be in a relatively poor state and requiring extensive repairs and reconditioning, buildings of this age should be in reasonable condition and the repairs required to keep them that way will be relatively minor (British Standards Institution, 2011, pp4-6) Although physically in good condition, the thermal performance of these buildings is likely to be poor. Built between 1955 and 1986, most of these buildings have no insulation or weather-stripping, and consequently have poor or very poor thermal performance, they typically use 4-6 times the energy of new dwellings for heating and cooling (Nationwide House Energy Rating Scheme, p183).

A large proportion of the dwellings built in the 1955 - 1985 period were detached houses and their repair and alteration is generally well understood and has been documented in both the popular architectural press and academic literature (Sustainable Buildings Research Centre, 2013, Judson and Maller, 2014, pp501-511). Less well understood is the current condition, repair needs, and thermal performance of the more than 650,000 multi-residential dwellings built in this period, mostly in the major East coast cities.

2. AUSTRALIA'S OLDER APARTMENT BUILDINGS

Australia's older apartment buildings manage to be simultaneously despised, ubiquitous and largely ignored. Despite being derided by architects as 'truly horrifying'(Boyd and Tsiolkas, 2015, p255) and 'box like blocks which march cheek by jowl down uninteresting streets in increasingly dull suburbs' (Pickett, 2009, p2), they flourished around train stations and in the inner suburbs of the east coast cities. At the same time they are largely ignored in research and writing about the era or the city (Pickett, 2009, p1).

Over 75% of these dwellings are of masonry construction[2] and share a core of common construction materials and methods – whether they are cheap low-rise walk up suburban flats or high-rise luxury apartments. They are almost entirely masonry structures: external walls are cavity brickwork while internal walls are double or single leaf brickwork, and floors are concrete slabs. Internally the brickwork is usually plastered and the underside of the concrete slab floor above is exposed as the ceiling of the unit. Roofs are predominantly low-pitched metal sheeting over timber or steel framing with minimal insulation. This heavy masonry

FIGURES 2, 3 & 4: TYPICAL 1960S AND 1970S APARTMENT BUILDINGS (PHOTOS BY AUTHOR)

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[2] Generated 23 August 2017 using data provided by the Australian Bureau of Statistics from the Census of Population and Housing 1947 - 1986

construction makes these buildings very durable and low maintenance but also makes repair or rehabilitation of the structures difficult and expensive – particularly once substantial cracks appear in concrete or damage to cavity ties occurs (Matrix Industries).

The construction standards and materials typical of the 1960s and 1970 are also a source of current problems. Asbestos, lead based paint, polychlorinated biphenyls and other toxic substances were in common use at the time these buildings were built (Alpha Environmental, 2016), so the removal of these dangerous materials will be an important part of the retention and improvement of these buildings. Many buildings of this age also fail to comply with current building codes and standards in dangerous ways. The rules around electrical safety and switchboards, fire sealing of penetrations in walls and floors, smoke ventilation to underground car parks, fire fighting equipment and balustrade height have changed significantly since their approval and construction (Australian Building Codes Board, 2015, City of Brisbane, 1972, City of Brisbane, 1967). Bringing older buildings into line with current codes and standards is also a key task.

The thermal performance and energy use of older apartment buildings does not require the urgent attention of the issues listed above but is still an important consideration. The thermal performance of these buildings across the various climates of the east coast of Australia is yet to be established, but preliminary modelling indicates it is relatively good, at least in Brisbane's benign environment. This is likely due to a combination of high thermal mass, and party wall and floor arrangements which result in reduced heat loss and gain from exposure to the outside environment. Previous research has confirmed that energy use for thermal comfort can be reduced by up to 70% through building envelope modifications of a case study building in Brisbane (Matthew and Leardini, 2017). Additionally, many of these buildings are ideal for the installation of solar PV power generation. Their extensive flat roofs make the installation relatively easy and they are rarely overshadowed being as large or large than their neighbours. They also usually have common space available for the future installation of battery storage systems.

By addressing and resolving end of service life issues, removing toxic and hazardous materials and improving the environmental performance of this cohort of buildings, a vast amount of resource use, construction waste and CO2 emissions can be avoided, or at least deferred for the remaining lifespans of these buildings.

When they are no longer able to be safely inhabited, large parts of the buildings are potentially able to be reused, and what cannot be reused can be recycled or down-cycled. Their metal roof sheeting is typically a low pitch long span which is clip fixed from below, making it ideal for reuse as there are no holes in the sheeting. The bricks used in the 1960s and 1970s are pressed rather than extruded, which makes them heavier, stronger and easier to disassemble for future reuse. Aluminium framed windows and sliding door suites could conceivably be reused if carefully removed but this may be problematic: they have a very low thermal performance and the glass usually does not comply with current codes and standards. A better solution is probably to disassemble them and to recycle the materials into new products. Concrete slabs are easily broken down and can be used as aggregate for new concrete or as road base or fill. The steel reinforcing, copper wiring and plumbing pipework within the slabs can also be retrieved during this process and recycled into new materials.

3. GOALS AND PROCESSES FOR APARTMENT BUILDING UPCYCLING

The retention and upcycling of older apartment buildings could work towards the following five goals:

1. Sensible: assess the condition of the structure and undertake the required remedial work to ensure the future durability of the building. Design for upcycling can proceed within the limit of the lifespan of the building and deconstruction can be planned for when materials will be most reusable rather then when the building become unsafe or risky (Cheshire, 2016, pp25-30).
2. Safe: remove or resolve clear risks to health and safety such as toxic and hazardous materials, obsolete electrical and gas installations, lack of fire fighting equipment and inadequate balustrades.
3. Sustainable: work to reduce the operational impact of the building by reducing unnecessary electricity use through improving thermal comfort and upgrading energy intensive services, installing renewable energy generation and storage systems, reducing water use and improving the quality of water leaving the site.
4. Comfortable: address thermal comfort issues in the building and resolve acoustic and visual privacy problems.
5. Pleasurable: buildings that give satisfaction and pleasure to residents and owners are more likely to be cared for (International Living Future Institute, 2016, p58).

Ideally, these outcomes would translate to the relatively clear and linear process shown below in Figure 3. Starting with engagement and briefing by the owners, a full assessment of the building by professionals and specialist contractors would be conducted, leading to a schedule of required and desired repair and improvement interventions. From this, clear decision-making on the selection and prioritisation of work would lead to defined staging of projects and ensure that work is done in a sensible order and cost effectively bundled. Individual stages could then be funded through increasing maintenance contributions from owners, special levies for particular projects or loans to the Body Corporate, which are paid for by increasing levies on owners. This would result in the entire upgrade project being accomplished over a 10 to 15 year period. Unfortunately there are some substantial issues that make this unlikely to occur.

The first issue is right at the very start of the process. At present there is no clear legal requirement to plan for the end of service life or to conduct a fundamental risk and safety analysis of the building. While there is a legal requirement for a ten-year schedule of maintenance, to be funded by a quarterly levy on all owners (Queensland Government, 2015, Antoniades), anecdotal evidence suggests that this typically contains basic maintenance tasks. Research is currently being conducted into maintenance and repair planning in older apartment towers in Brisbane that will provide clearer information in this area. While there is a self interest in keeping the building safe and in complying with Disability Discrimination Act, this often takes the form of eliminating the most common causes of legal action (slip and trip hazards), and ignores more substantial and fundamental issues such as balustrades, electrical safety and fire fighting equipment.

A second issue follows on directly from the first: even if the need for a substantial repair or improvement to the building is recognized by the owners, it is unlikely that they have the

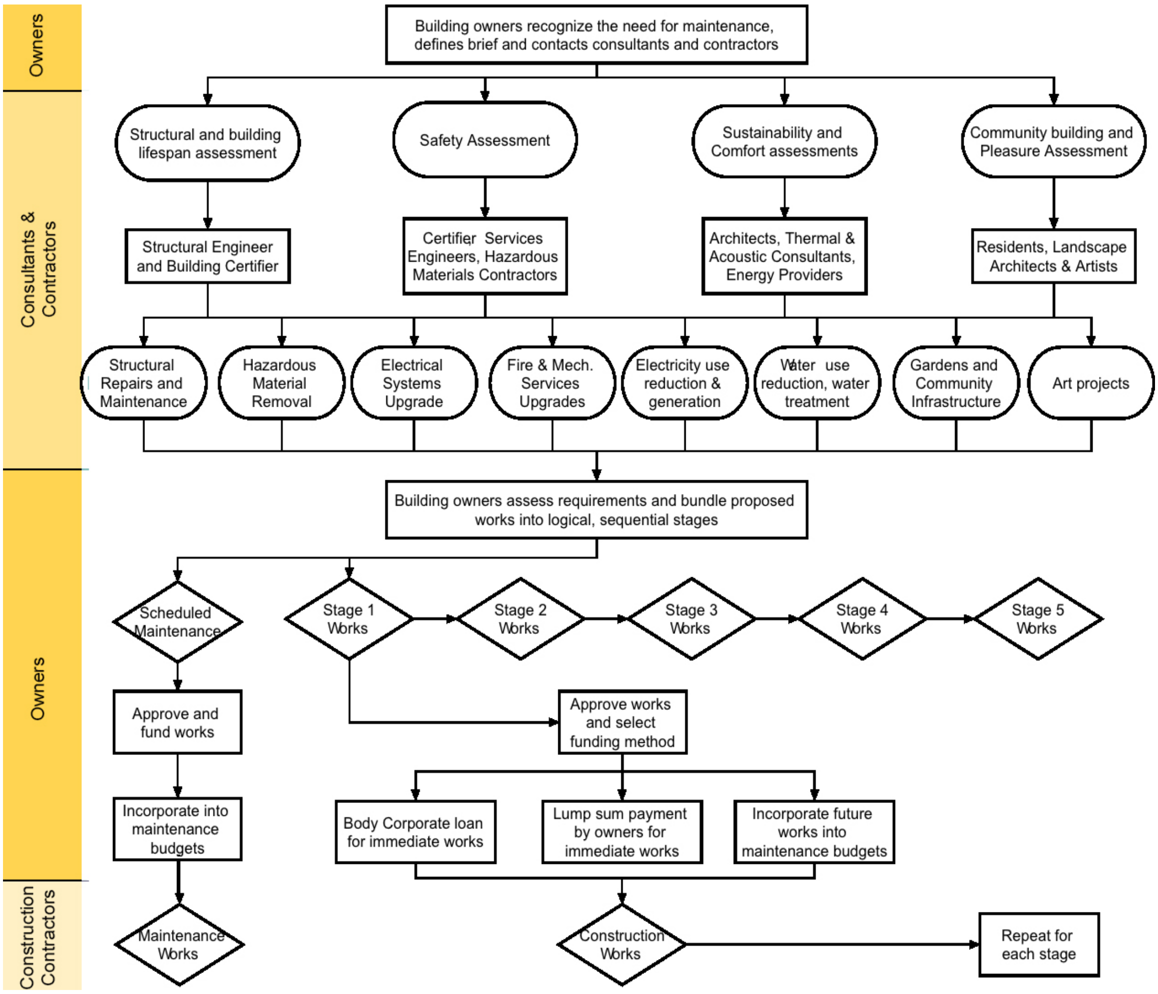

FIGURE 7: PROJECT PROCESS FOR UPCYCLING EXISTING MULTI-RESIDENTIAL BUILDINGS

knowledge and skills to assemble and brief the large team of specialist consultants and contractors who will inspect and report on different aspects of the building, or to compile the resulting reports into a coherent set of staged construction works. Commercial buildings have dedicated managers who can complete these tasks but multi-residential buildings may need to engage a professional to complete this work. The technical and organisational aspects of this work are ideal for architects, project managers, building surveyors and other construction professionals but this is often outside their usual range of services and fee structures.

The third factor is that there is no clear and unambiguous regulatory requirement to bring older buildings towards alignment with current codes and standards. The primary national regulation for buildings – the National Construction Code (NCC) is almost entirely focussed on new construction, and provides little direct guidance about the situation of existing buildings (Australian Building Codes Board, 2015). The publisher of the NCC also provides a Handbook for Upgrading Existing Buildings but this book assumes that the requirement to upgrade a building is already known and agreed – it provides no trigger to force a building upgrade and, in any case, compliance with this guide is not required (Australian Building Codes Board, 2016, pp6-9).

In most cases it is State or Territory legislation that provides some guidance on when an upgrade is required: in Queensland, this is the Queensland Building Act (1975). Clause 81 is generally understood to mean that if a building or part of a building was code compliant at the time of construction then there is no requirement to bring it up to the current NCC code. The counter to this is Clause 80, which states that if an existing building is considered ‘unsafe’ then it might be required to be brought up to current code. However, ‘unsafe’ is not defined in the legislation and neither is the mechanism by which someone could decide whether an upgrade is required or not. Furthermore, Clause 80 only applies when building is already undergoing some kind of construction work, and cannot be said to apply in other circumstances (Building Act 1975 (Queensland)).

Furthermore, courts have created precedents that extend and amplify this legal ambiguity. Some court cases have confirmed that there is no requirement to bring whole buildings or their individual elements up to current codes, particularly if the owners do not know that parts of the building are dangerous (Farmer, 2017, Kerin, 2015). In at least one other case, the court has found that owners do have an obligation to bring elements of their buildings up to current code and that owners and property managers ‘must take reasonable care in respect of dangers not readily apparent on inspection’ (Vedelago, 2010). While sensible risk management principles, such as those outlined in ISO31000:2009, should be used by body corporates to protect their residents and care for their building, a lack of professional skills can make this difficult. As is often the case, the absence of clear legal requirements and responsibilities leads to inaction.

The fourth and final impediment to the workflow or process is the willingness and ability of building owners to agree on and fund the repair and improvement works. Decision-making in multi-residential buildings is complex, with all owners having a vote on maintenance and repair decisions. More than two thirds of multi-residential dwellings owned by investor owners who live elsewhere[3] and who have different set of priorities to the third of owners who live in the building (Littlewood and Munro, 1996, pp505-506, Dubin, 1998, pp150-151). The attachment felt by owner-occupiers and the disconnection demonstrated by investor owner decisions complicates the financial disparities between those who own apartments outright and those who continue to pay a mortgage.

4. POLICY CHANGES TO IMPROVE UPCYCLING PROSPECTS

The first and third of these impediments have clear and, at least in theory, easy solutions. The lack of requirement to perform a structural and services safety check at the end of the service life of a building and at regular intervals thereafter could be fixed by amending legislation in each state. A precedent for this is the New South Wales regulations that require passenger vehicles more than five years old to pass a safety check by an authorised mechanic before registration can be renewed (Roads and Maritime Services, 2016). A similar law could require all strata or corporate titled buildings to pass an inspection covering structural integrity and basic fire, electrical and movement safety issues at their end of service life period and at ten or twenty year intervals thereafter. Failure to take required remedial action would result in the building being declared un-safe and access to the building being blocked until the issues are rectified. Similar powers are already held by the Queensland Fire and Rescue Service, who can prohibit the use of buildings they deem a risk to residents or adjacent buildings. (Fire and Emergency Services Act 1990 Queensland).

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[3] Generated 23 August 2017 using data provided by the Australian Bureau of Statistics from the Census of Population and Housing 2016

Similarly, the NCC and state legislators could create clarity around the requirement to bring buildings towards alignment with current codes by removing the existing tangle of legal precedent and legislation. A legal framework that clearly describes the triggers for bringing existing buildings up to current code would not only assist with the maintenance of older building but also result in a safer built environment. Once again there is an existing legal precedent for this: in January 2017 the Queensland government passed laws requiring all dwellings to comply with new rules for smoke detectors, with a ten year, staged process for full compliance. All new buildings must comply as of January 2017, all buildings must comply at point of sale or lease by 2023, and all other buildings must comply by 2027 (Queensland Government, 2016).

The second and fourth impediments to the on going retrofit of older multi-residential buildings: the lack of skills and knowledge within body corporates and the complex decision making by diverse ownership groups, are not so simply resolved. However, their impact would be greatly reduce once the legal requirement for building improvement was established. Without this legal requirement, the resistance to action within body corporates might change in response to public perception and market pressures. If these buildings began to lose value as a result of the public perceiving them as unsafe, or buildings began to be demolished as a result of delayed maintenance and repairs with a sudden loss of capital and income to owners, then resistance to spending money on the building might be reduced.

5. CONCLUSIONS

Although Australia’s built environment is relatively new, a substantial portion of it is approaching the end of its service life and will require increased maintenance and repair over the coming twenty years. A large number of these buildings are multi-residential apartment buildings constructed between 1956 and 1986, which share common construction methods and materials. With prompt maintenance and repairs these buildings could continue to provide safe and comfortable accommodation for a further 50-75 years but without it they could be uninhabitable in as little as 20 years. Their retention and upcycling will principally contribute to the circular economy by reducing and delaying the need for new construction, allowing the industry to further develop low carbon and low energy materials and techniques. Additional benefits will be the development of skills and networks in the construction industry and the cataloguing materials in these buildings for later reuse in new buildings.

At present there is no clear legal requirement for owners to attend to the long term health of buildings or to bring them up towards current codes and standards. This, along with the complexity and diversity of the owners of individual buildings, is likely to result in an earlier demise rather than a later one, as well as less safe and comfortable buildings in the meantime. Action by State governments could create the legal requirement for building structural and service safety inspections that would detect building faults and issues early on and help to extend the life of buildings. Additional clarification about the need to bring existing buildings towards alignment with current codes by both State governments and the administrators of the National Construction Code would provide owners with a clear need to act to improve the safety and environmental performance of older buildings.

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