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**Chapter 2: The philosophy and definition of retrofitting for resilience**

**Sara Wilkinson & Sarah Sayce**

(5600 words)

## 2.1 Introduction

This chapter starts by defining retrofits and distinguishing this from other forms of building alterations in order to distinguish a retrofit for resilience against a normal cyclical undertaking to bring a building back to extant occupational functional standard. It considers the timing at which retrofitting takes place and distinguishes 'deep' and 'light' retrofit approaches. The chapter then expands into a discussion as to what constitutes a 'resilient' building as distinct from an 'environmentally' friendly' or 'sustainable' one and the extent to which the terms are complementary. It argues that, if building resilience is to be achieved, sufficient to assist in meeting climate mitigation targets, not only is retrofitting buildings simply a necessity, it is a desirable social outcome, conserving as it may do, the maintenance of place, memory and culture.

The chapter debates what happens when place and community are lost for example, as in the London Docklands, and provides some examples of where buildings have achieved a new life. The chapter explores the extent to which retrofitting to preserve – or conserve - the social value of the building and its context is a philosophical, economic or legislative matter before highlighting the issues of the redevelop/retrofit decision. Finally, the chapter emphasises where the business-as-usual approach is lacking and outlines the radical and drastic alterations needed to our current conceptual understanding to deliver the necessary changes.

## 2.2 Types of retrofitting:

### 2.2.1 Retrofit

Retrofitting is the process of modifying something after it has been manufactured: in this case a building. There are various degrees of retrofit from light to extensive or deep retrofit. Deep retrofit is a term associated with extensive energy upgrades to the building fabric and envelope (Rocky Mountain Institute, 2020).

Retrofitting a building involves changing its systems or structure after its initial construction and occupation (City of Melbourne, 2021). This work can not only restore functionality but improve both the amenities of the building for the benefit of its occupants and improve the technical performance environmentally. As technology develops over time, building retrofits can significantly reduce energy and water usage and improve sustainability performance; further, as climate change, for example, rising temperatures, retrofitting may be essential if the building is to remain functional. This has been brought sharply into focus, as weather patterns start to change more rapidly that previously predicted, making some buildings constructed only a few years ago, already requiring technology upgrades to combat extreme heat[1]. There are several terms used in different countries to describe retrofit; these are defined below. What is relevant to the discussion in this book is the

[1] For example, it is claimed that many new homes built in England since 2018, already need cooling systems installed to combat rising summer temperatures https://www.telegraph.co.uk/environment/2021/07/10/homeowners-face-9000-bills-stop-new-builds-overheating/

notable absence of a connection between definitions of retrofit and the principles of circularity. This point is explored later in the chapter.

### 2.2.1 Refurbishment

In the UK, the term refurbishment is used to describe building adaptation and retrofit (Wilkinson et al, 2014). During a refurbishment a building is improved above and beyond its initial condition or brought up to extant building compliance standards. This is a good example of different terms being used to describe the same set of activities. According to the City of Melbourne (2021), refurbishments are often focussed on aesthetics and tenant amenities, but can also include upgrades to a building's mechanical and electrical systems to improve energy and water efficiency. Therefore, it can be argued that the terms are sometimes useable interchangeably – but it is always critical to understand what is being described to ensure clarity.

### 2.2.2 Renovation

Similarly, renovations are very similar to refurbishments and the terms are sometimes used interchangeably. The major difference is the term renovation applies specifically to buildings, while refurbishment does not (City of Melbourne 2021). As with refurbishments, renovations often focus on aesthetics and tenant amenities, but may include upgrades to mechanical and electrical systems and therefore, potentially, have a positive effect on energy and water efficiency (Gustafsson et al., 2017). Renovation, as defined in the Oxford dictionary [2] also applies to the process of bringing buildings which have fallen into disrepair up to the expected 'norms' of performance and specification; it implies repair, bringing into condition and some rebuilding.

### 2.2.3 Retro-commission

Commissioning is the process whereby newly installed building services are tested and adjusted to ensure they are functioning correctly prior to formal handover from the project team. Retro-commissioning is performing the same process on a building that has been operational and occupied for a period with the purpose of ensuring it continues to meet the design intent and the needs of the occupants. Some experts recommend retro-commissioning or re-commissioning a building once every three to five years. This is considered vital given that many new build, and retrofitted buildings, in practice, fail to operate at designed standards: the so-called energy performance gap (see Van Dronkelaar et al. (2016) for a review of the causes of the gap).

If a building is not properly commissioned, has had changes to its systems and operating conditions made since commissioning, or has had its performance degrade over time, retro-commissioning may make its existing systems more efficient (Jump et al, 2007). Further as the ability to monitor water and energy use improves using 'smart' meters and other devises aimed at enhancing efficiency and reducing resource use, so retro-commissioning makes increasing environmental – and economic – sense.

As with initial commissioning, retro-commissioning can be carried out by the contractors who installed the building's mechanical systems or by a third party who specialises in commissioning.

### 2.2.4 Tune-up

[2] https://www.oxfordlearnersdictionaries.com/definition/american_english/renovate

Finally, ‘building tune-up’ is a generic term that may encompass maintenance on the building’s existing systems, or aspects of retrofitting and retro-commissioning. Many cities globally have implemented building tune-up programmes with the goal of improving energy and water use efficiency (Balinger, 2020).

**2.3 Defining a Resilient Building**

Defining a resilient building is challenging; it is also a comparatively new addition to the real estate lexicon. It is critical to the arguments put forward in this book that it is understood to be distinct from, for example, a ‘green’ or environmentally friendly building. To many, a sustainable building is viewed only in terms of energy efficiency and/or water saving technologies; others focus on the importance of materials and embodied carbon in reducing the whole life footprint of the building. Further definitions of sustainable buildings extend beyond the fabric to user behaviours which exercise considerable, variable, impacts on the amount of delivered building performance. Whilst some aspects of ‘sustainability’ can be built in through design and original construction, the process of retrofit is key to climate targets, given that most buildings were not built with carbon neutrality in mind and are certainly not ‘future-proofed’. Indeed, it is argued that in countries, such as the UK, where old stock dominates, up to 85% of buildings require extensive work to make them resilient in carbon terms. Some of course, for physical or heritage reasons, simply cannot be made truly carbon neutral.

However, the concept of resilience in buildings is altogether wider than that of zero carbon in use. It places the building into its physical, economic and social context; however, it is argued to be distinct from a ‘green building ‘(Hewitt *et al.,* 2019). Even sustainability could still be as contested today as it was nearly thirty years ago when Cook and Golton (1994) argued that definitional disputes could not be settled by appeal to more reference to empirical evidence, linguistic usage, or the canons of logic alone. Sustainability is also based on our lived experience and beliefs with people interpreting information differently (Wilkinson, 2012). Applied to buildings, sustainability embraces longevity, adaptability, low resource impact, location sensitivity and the notion of likeability – or appeal to our sensitivities.

As such environmental impacts can result from products specified, how the building is constructed and how it is operated during the lifecycle including maintenance, repairs and retrofits (or refurbishments) and finally, the end-of-life demolition and potentially reusing or recycling and disposal of the building materials, fabric and structure. This is summarised in figure 2.1 below. Phillips et al (2017) contend that each stage has sustainability issues and impacts and resilience issues and impacts.

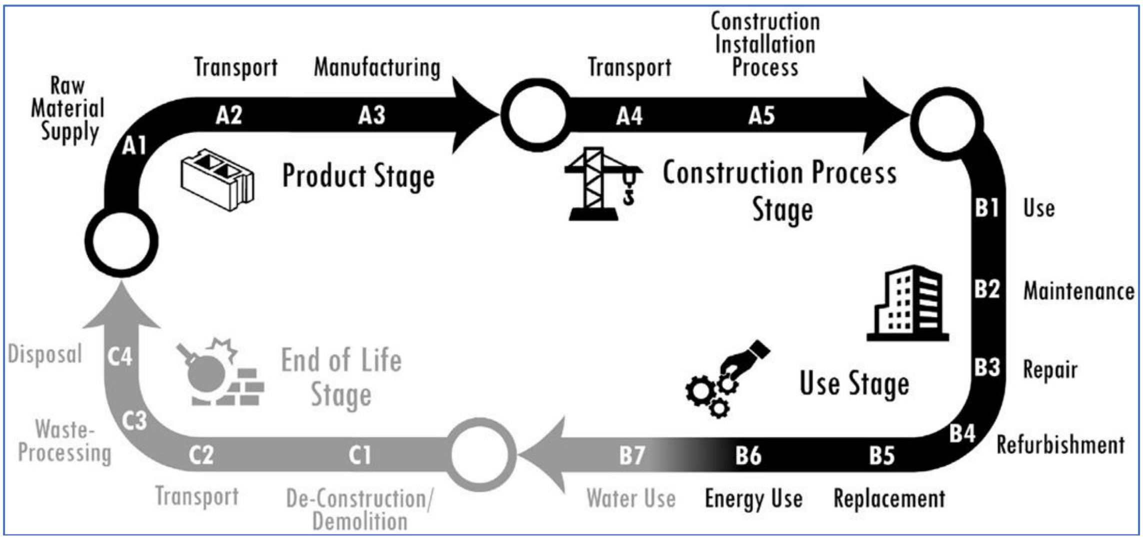


*Figure 2.1. Building life cycle stages from Phillips et al. (2017:299) who adapted it from BS EN 15978*

Figure 2.1 considers sustainability in the context of an evaluation of resilient strategies. Stages A1–B6 form the basis of the sustainability evaluations. Greyed processes (B7–C4) are those which move from a linear to a circular life cycle, but which were not considered by Phillips et al (2017).

In the disciplines of engineering and construction, resilience is the ability to absorb or avoid damage without suffering complete failure and is an objective of design, maintenance and restoration for buildings and infrastructure as well as communities. Moazami et al., (2019) posited two definitions for robust and resilient building in respect of dealing with and preparing for climate uncertainty as;

**Definition 1**: A robust building is a building that, while in operation, can provide its performance requirements with a minimum variation in a continuously changing environment (Moazami et al., (2019),

Robustness emerged in the 1940s as a concept that meant products, technologies or products had the characteristic whereby they were not sensitive to factors causing variability and ageing. Significantly this period coincided with the second world war and/or the period immediately after when resources were scarce globally.

**Definition 2**: A resilient building is a building that not only is robust but also can fulfill its functional requirements (withstand) during a major disruption. Its performance might even be disrupted but has to recover to an acceptable level in a timely manner in order to avoid disaster impacts.

Two critical variables were identified in their research, functional and performance requirements. The *functional requirements* define what a building has to do, and the *performance requirements* determine how well a functional requirement has to be done (Wilde, 2018).

Using these definitions Moazami et al., (2019) proposed a conceptual figure to illustrate the relationship of robustness and resilience in respect of functionality and performance. Figure 2.2 below shows that robustness is part of the typical expectation of buildings which is weakened by unforeseen and extreme events, but which may recover to an acceptable or even, design performance level. Resilience on the other hand covers the whole scope of foreseen and unforeseen events.

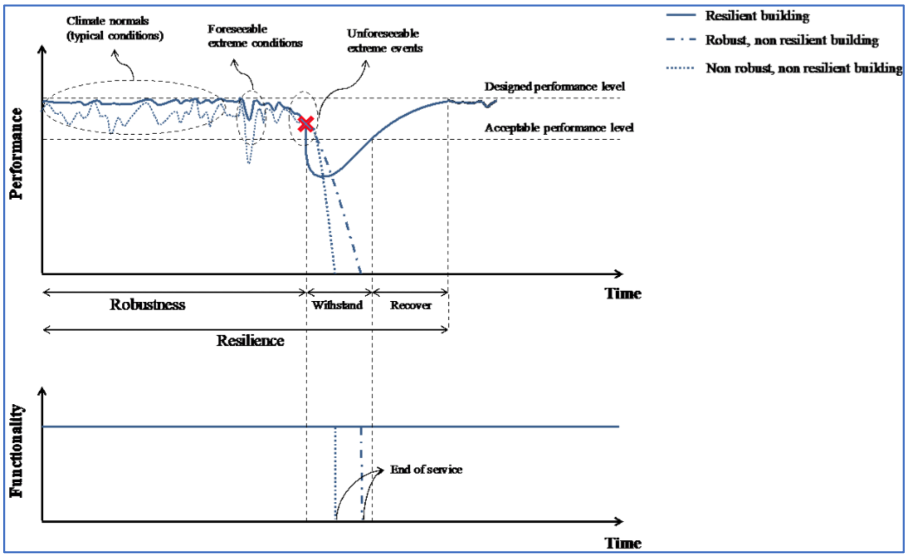


*Figure 2.2 Conceptual framework for robust resilient buildings (Moazami et al. , 2019:5)*.

However, this framework only covers climate related events only such as flooding and extreme heat, whereas true resilience should not only all climate hazards, including storm, but also economic and social impacts. Economic impacts, such as variable demand tends to lead to the need to re-purpose whereas social impacts, including legislative and technology change can require changes to meet the needs to protect health, such as witnessed in the Covid-19 crisis, as well as legislation to ensure fair access to buildings by those with disability.  These factors combine to make the process of, and design for, retrofitting, critical, if our buildings are to 'live' for their maximum timespan – as Brand argued so many years ago (Brand, 1997). We need to help our buildings learn – and then we need to learn with them and respect them, seeking to prolong their existence where appropriate to aid maintenance of cultural history. This theme is picked up below in section XXX

At this point, before moving on it is important to distinguish between in-use adaptation and across use. The latter – for example retrofitting an office to a flat is an example of the latter; but configuring a standard office into a one that supports, for example, co-working, is in-use adaptation. Where this can be achieved, it is more likely to retain the social identify of area.

It is useful to finish this debate by including an earlier conceptualisation of resilient buildings was put forward by Arup as part of the 100 Resilient Cities Agenda, which are set out in Table 2.1.

**Table 2.1 Qualities of Resilient Buildings**

| Quality | Characteristics |
|---|---|
| Reflective | where buildings are able to accommodate uncertainty and change, with the ability to evolve based on emerging evidence |
| Robust | where buildings are well conceived, built and managed so they can withstand impacts without significant damage and loss of function.  Avoiding over-reliance on any single component makes the building less vulnerable to catastrophic collapse |
| Redundant | where buildings have capacity to accommodate disruption and/or demand surges. Diversity increases capacity and ways of achieving different functions. |

| | |
|---|---|
| Resourceful | this is the ability of people and organisations owning and managing buildings to find alternate ways to meet needs and achieve goals when experiencing shocks or stresses. Resourcefulness is vital to restore building functionality of critical systems when severe conditions prevail. |
| Inclusive | where the need for broad consultation and engagement of all members of society is recognised. Intra societal equity is a fundamental component of resilience. Adoption of inclusion results in shared ownership and joint vision to build resilience. |
| Flexible | acknowledging change is inevitable, building design should accommodate changes to technology and space plans |
| Integrated | alignment and integration for consistency in decision-making across all scales. Here, scales include the design team, engineers, planners, contractors, as well as building users and regulatory bodies (planning and building compliance). Effective knowledge exchange between stakeholders enables them to function collectively and respond rapidly through effective communications. |

(Source: Authors and Arup, 100 Resilient Cities, 2014:7).

In conclusion, in seeking to distinguish resilient buildings from sustainable ones, it is useful to refer to the definition given by Jennings et al. (2013) (quoted in Phillips et al.,2017: 296). This concludes that a resilient building can "*resist physical damage, may be quickly and cost-effectively repaired if damaged, and maintains key building functionality either throughout a disruptive event or restores a target operation level more quickly after such an event occurs.*"

Taking this framework and the literature detailed above, but also drawing from wider literature including the economic context explored by Ellison and Sayce (2007), it is posited that, truly resilient buildings are those which are:

1. At low risk from external hazards and physical climate events such as wildfires, drought or flooding or sea level rise;
2. Designed or adapted to use renewable energy and natural heating /cooling systems such that they can operate with minimal or no support from external sources and preferably with 'back-up supply;
3. Durable in structure, but adaptable both in-use and across uses;
4. Conducive to good health and well-being, and located away from unhealthy external, polluting environments;
5. Accessible and allow of easy connectivity to the markets or communities they service, and with low reliance on solely road access;
6. Able to recover quickly from external shock i.e. are able to repaired using readily available local materials and labour.

From this it can be argued that resilience is a moving target which requires continued investment; this is explored below.

**2.3 The case for retrofitting: overcoming obsolescence**

There is nothing new in the requirement for retrofitting: Panta Rhei or, 'life is flux' is attributed to Heraclitus of Ephesus, a Greek philosopher, who made this profound statement around 500 years BC (Ancient History, 2021). Some 2500 years later, this remains true: the only constant is change. Change as we know, can be slow or fast, predictable or unpredictable. Furthermore, change has many dimensions: it can be political, economic, social, technological, legal and/or environmental. Change can have single or multiple causes and consequences.

It has long been recognised that, over time, buildings may experience a decline in utility or usefulness (Baum, 1993; Mansfield & Pinder, 2008; Pinder and Wilkinson, 2001; Salway, 1986;) and this is recognised as a sustainability issue (Reed and Warren-Myers, 2010). It used to be thought that the lifespan of a building would be determined by the longevity of its fabric and that problems of obsolescence were relatively innocuous. Bowie's short seminal article (1982) demonstrated the fallaciousness of that argument. Today, most building types are increasingly prone to obsolescence because of the functional, economic and social requirements being placed on them by economic shifts, revolutionary technologies and emerging cultures (Nanyakkara et al. 2021).

From the point of first occupation, buildings physically deteriorate, and the capital invested in them undergoes a gradual process of devaluation; as buildings age and decay they suffer diminished utility, requiring a constant stream of capital investment (Mansfield & Pinder, 2008. Bryson, 1997). Nevertheless, physical deterioration of buildings is largely a function of time and use and can be controlled to some extent by selecting appropriate components and materials at the design stage, and by correct, planned, maintenance (Chanter and Swallow, 1996;Thomsen & Van der Flier, 2011).Further a building that retains economic or social relevance, possibly through locational advantage or historic importance, will present a case for investment to combat physical deterioration, as the existence of many heritage buildings testifies. Furthermore, life cycle cost analysis (LCA) facilitates choice between alternative design options (Kishk and Al-Hajj, 1999).and helps identification of issues that, potentially, lead to deterioration (Crawford, 2011).

Physical deterioration should not be confused with a building's decline in utility due to a failure to satisfy new needs created by changes in equipment, materials, style, laws and the many other forces that cause a building to lose desirability in the eyes of its user and hence suffer from obsolescence (Grover and Grover, 2015; Mansfield & Pinder 2008; Pourebrahimi *et al.* (2020); RICS, 2013; Sayce *et al.* 2004). More specifically, obsolescence describes a relative decline in the utility of a building that does not result directly from physical usage, the action of the elements or the passage of time (Baum, 1993). Instead, obsolescence is caused by changes in peoples' needs and expectations regarding the use of a particular building (Thomsen & Van der Flier, 2011). Utility - the sense of usefulness, desirability, or satisfaction - is central to the concept of obsolescence; if a building does not provide utility, it will be considered obsolete (Smith et al., 1998). The Golf Club House, Rochford Hall, in Rochford Essex England is a good example of an 800-year-old building that has had several uses during its lifecycle which inevitably become obsolete (Wikipedia, 2021). These uses range from medieval Hall, to fortified Tudor house and Boleyn family home, complete with moat, to its current use of Golf club.

However, there is no objective measure of utility for buildings and, if there was, it is unlikely that the changes over time would be represented by a straight line; the pattern of change would be more complex (Mansfield and Pinder, 2008. Khalid, 1993). The lack of an objective measure of building utility presents two problems. The first problem is that obsolescence is difficult to control. In contrast to the gradual process of physical deterioration obsolescence occurs at irregular and unpredictable intervals and is concerned with uncertain events, such as changes in fashion and technology, as well as innovation in the design and use of buildings (Ashworth, 1999). The range of variables and the unpredictability of some of these influences imply that a general model of obsolescence is not feasible (Thomsen & Van der Flier, 2011. Golton, 1989) and the scope for preventative action appears limited (Salway, 1986). The second problem is that obsolescence is a relative matter, which means that rational, consistent measures are very difficult to produce and are subjective (Thomsen & Van der Flier, 2011). This subjectivity derives from the fact that perceptions of obsolescence change relative to a particular situation or condition and vary according to the viewpoint or interest of the observer; obsolescence is a function of human decision rather than a consequence of 'natural' forces (Mansfield & Pinder, 2008; Cowan, 1970).

Historically, the problem of measurement has been overcome by focusing upon the financial impact of obsolescence, by measuring obsolescence in terms of a real or nominal decrease in building value. Baum (1993) and Khalid (1993) used the financial impact of obsolescence to measure the effects of obsolescence on the depreciation of office buildings in the investment property market. The limitation of the financial approach allows us to isolate two forms of obsolescence.

Building obsolescence 'occurs when a building's stream of rental payments bears little relationship to the rental payments usually obtained from that location' (Bryson, 1997; p.1446). It is therefore concerned with buildings' physical characteristics, as determined by design and specification. Locational obsolescence occurs when buildings located within a particular area suffer from devaluation because the area is seen has less attractive by current or prospective occupiers (Bryson, 1997). Locational obsolescence results from changing expectations of infrastructure, communications, and environmental conditions (Cowan, 1970; Lichfield et al., 1968). It is much more difficult for an individual building owner or user to remedy the causes of locational obsolescence, whereas building obsolescence can often be remedied by retrofit (Wilkinson & Remoy, 2018. Wilkinson et al., 2014) or imaginative re-use and repurposing.

Renewal, which involves demolition and replacement is time consuming and expensive. Furthermore, renewal under current practices, typically results in most materials and components going to landfill waste. This is inherently unsustainable; the aim should be to promote circularity where possible. This is the argument increasing put forward – notably recently by the RIBA (Royal Institute of British Architects) who argue that there should be a presumption in favour of retrofit as "every year 50,000 buildings are demolished in the UK, producing 126 million tonnes of waste, which represent two-thirds of the UK's total waste. [3] Retrofit retains the embodied carbon in building materials, and typically costs much less than renewal and can be delivered in shorter time frames. Increasingly in the debate around retrofit terms such as resilient and sustainable are incorporated (Wilkinson & Remoy 2018). What do these terms mean; and moreover, do they compete, or are they compatible and overlapping?

Since many of the above reports were written and debates rehearsed, both Climate change and Covid-19-19 have become major relevant issues. They provide examples of change that require immediate and urgent responses; the former is multi--cause and has initially been slow – but no more; the latter has shown how a health issue in one country can spread quickly to become a health issue in every country. In just one year, climate change has triggered deep concerns and accelerated awareness as it caused sudden loss of life by fire and flood in many parts of the globe, from Canada to Turkey in terms of fire and Germany to China for floods. Covid-19 became an economic issue as workplaces shut down and some sectors experienced closure and unemployment. The issue then becomes politicised within countries and across countries around issues of cross border travel and distribution of vaccinations for example (National Geographic, 2021); further Covid-19 creates social tensions and has implications for mental health and well-being that are only now beginning to be recognised as having long-term impacts.

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[3] realassetinsight.com/2021/07/12/riba-demolitions-should-be-stopped-to-lower-emissions/#:~:text=The%20Royal%20Institute%20of%20British,net-zero%20targets%20by%202050.&text=Every%20year%2050%2C000%20buildings%20are,of%20the%20UK's%20total%20waste.

When it comes to the building stock the above factors, combined with digital transformation, changes to social mores and many more factors, combine to become drivers for retrofitting buildings which are no longer fully fit for their original purpose. However, critically, it is argued, blanket assumptions that retrofits to achieve changes across use, can create as many problems as it solves. This is evidenced by conversion of obsoleted offices to flats with no outdoor space; not only do many provide poor quality accommodation (Ferm at al., 2021) but the impact of both Covid-19 has increased the desire and health requirement for outdoor space – something which office conversions seldom offer; and at worst they can present health risks from rising temperatures[4]. This underscores once more the need for *appropriate* retrofit measures.

### 2.4 Resilience at the City level

According to the 100 Resilient Cities Framework (Arup 100 Resilient Cities, 2014:5), 'City resilience describes the capacity of cities to function, so that the people living and working in cities – particularly the poor and vulnerable – survive and thrive no matter what stresses or shocks they encounter'. As such, the definition includes physical, social and economic aspects. Their understanding derives from a historic review of the concept of resilience dating from the 1970s and the field of ecology (Walker and Cooper 2011). This is transferable to cities when stresses and shocks threaten to cause disruption or collapse to social and physical systems. A limitation is that this conceptual framework does not include governance and power dynamics. Using this definition, resilient systems are said to feature the following seven qualities summarised in Table 2.2.

**Table 2.2. Qualities of Resilient Systems**

| Quality | Characteristics |
|---|---|
| Reflective | where systems are able to accommodate inherent, increasing uncertainty with mechanisms which evolve based on emerging evidence, rather than adhering to fixed solutions based on the status quo. Using people's experiences and learning future decision-making frameworks evolve. |
| Robust | where systems are well conceived, built and managed so they can withstand impacts without significant damage and loss of function. Design considers future risks and potential failure, ensuring minimal safe, predictable failure occurs. Furthermore, avoiding over-reliance on any single asset is avoided as this makes the system vulnerable to catastrophic collapse. |
| Redundant | where systems have spare capacity to accommodate disruption, pressure or demand surges. Diversity is a key component as it increases capacity and ways of achieving different functions. Examples are distributed infrastructure networks and resource reserves. The aim is that redundancies are intentional and cost effective, prioritised at the city scale and not an externality of inefficient design. |
| Resourceful | this quality is defined as the ability of people and organisations to find alternate ways to meet needs and achieve goals when experiencing shocks or stresses. This can include the capacity to predict future conditions, set priorities and plan by mobilising social, economic and physical resources. The quality of resourcefulness is vital to restore functionality of critical systems when severe conditions prevail. |
| Inclusive | where the need for broad consultation and engagement of all members of society is recognised. Intra societal equity is a fundamental component of resilience. Adoption of inclusion results in shared ownership and joint vision to build resilience. |

[4] see https://www.theguardian.com/society/2021/aug/01/converted-offices-pose-deadly-risk-in-heatwaves-experts-warn

| | |
|---|---|
| Flexible | this characteristic acknowledges change is inevitable. Flexibility can be achieved through willingness to adopt new ideas, knowledge and technologies. Importantly there is recognition of the value of indigenous and traditional knowledge in resilience |
| Integrated | alignment and integration that promotes consistency in decision-making across all scales. Effective knowledge exchange between systems enables them to function collectively and respond rapidly through effective communications |

(Source: Arup, 100 Resilient Cities, 2014:7).

These qualities, whilst developed for the city scale, are also relevant to the building scale. The characteristics of resilient buildings have been considered in Section 2.2. above.

Four categories were established by the 100 Resilient Cities for urban resilience; health and well-being, economy and society, urban systems and services and leadership and strategy (Arup 2014: 13-15). The relevance to building retrofit in the health and well-being category is ensuring the building promotes physical and mental well-being, as discussed above. Examples would include providing spaces for people to enjoy proximity to nature, external green areas; or where this is not possible use of green walls and roofs. Other examples are use of materials which do not off gas or give off odours that might affect health.  Minimal human vulnerability involves ensuing health and safety measures are included in the building to avoid accidents and the systems are robust to minimise the likelihood of systems failure, such as power outage for example.

Health and wellbeing at the city scale include the opportunity for employment for people, at the building scale clearly some land use types commercial, industrial, and retail offer employment opportunities. As such, best practices in design of workstations and amenities should be adopted.

Where economy and society are concerned at the building retrofit level, the city scale categories are collective identity and mutual support, social stability and security and availability of financial resources and contingency funds. Within organisations occupying and/or managing buildings qualities such as inclusivity are recommended to improve resilience. Social stability and security can include provision of public space where applicable, and adoption of design measures that enhance safety and security of occupants and visitors. Availability of financial resources and contingency funds relates to prudent financial management of the property by the owners to ensure effectives repairs are undertaken in a timely way and regular maintenance and upgrading is provided.

For urban systems and services, the categories are reduced physical exposure and vulnerability, continuity of critical services and reliable communications and mobility. At the building scale, this involves the acknowledgement the building plays in the urban system for example, retrofitting green roofs will contribute to attenuation of the urban heat island or can provide additional surfaces to reduce stormwater runoff into the drainage systems (Balsells et al., 2013). Where buildings are in earthquake zones, ensuring retrofits include best practice measures to minimise collapse potential is an example of resilience. Looking at critical services in buildings; this includes power for heating, cooling, and lighting; water services; and internet and communications infrastructure. Retrofits should consider having renewable energy or some renewable or emergency power capacity, storage of water and equipment that reduces water consumption with use of recycled water where possible. Temporary emergency power supply would enable IT and communications infrastructure to work, as long as city scale infrastructure is operating. Effective property / facility management policies and plans are also needed to deliver all these operational outcomes (Siriwardena et al, 2013).

The last category at the city scale is leadership and strategy. There are three subcategories: effective leadership and management, empowered stakeholders, and integrated development planning. At the resilient building retrofit scale, effective leadership and management involves having knowledgeable leaders and consultants who are aware of the local resilience issues at the city scale and how these relate to the building scale (Roostaie et al., 2013). In planning the retrofit, effective communication and discussion of all relevant issues is required for effective decision-making (Wilkinson et al., 2014). Being open to new ideas and innovations is important and having an environment where these can be explored and debated is vital. The second sub-category empowered stakeholders involve the acknowledgement and recognition of all stakeholders from investors to occupiers. Consultation and education are also best practices to ensure resilience issues are identified and discussed (Siriwardena et al., 2013). Empowered stakeholders are far more likely to deliver resilient building retrofits that will work during the retrofit and after. Integrated development planning involves effective communication across different stakeholder groups from regulatory bodies, to contractors, design teams, to occupiers and visitors. In this way relevant resilience issues are discussed and debated at all stages of the retrofit project and building lifecycle. Adopting this approach will increase the likelihood of resilience being achieved in practice.

**2.5 Understanding Social Value and the role of place**

Social value is not a new concept; however it is framed by the mores to which communities adhere and therefore what constitutes social values change over time. Change in these values, which relate to ethics and morals, also impact our expectations of individual and organisational behaviours. This has recently been clearly demonstrated, with intensification of a search for equality, health and well-being, rights and planetary protection.

Social values set the ground rules for what governments, corporates and individuals do and expect of others. Today, widespread awareness of, and concern about, climate change and more recently, Covid-19, have reshaped what is, or is not, acceptable socially. We expect our buildings to offer more than shelter; they need to be resilient and support health and well-being. As these social values are increasingly articulated, so retrofitting is required.

One example of the growth in interest in putting social values in the heart of decision making and which, *inter alia,* affects building contract work is the UK's Social Value Act 2012. This placed a requirement on public sector procurement processes to seek, not just economic benefit, but social and environmental returns. This has provided a catalyst to those seeking government contracts to develop their own corporate social responsibility policies; without them, they can no longer bid for work. One year on, an early evaluation (UK Gov, 2013) pointed to examples of contracts, including building repair, being granted based on 'full triple bottom[5]' criteria.

As in other fields of endeavour, defining social value within the built environment context has been difficult. Value has been, and indeed largely still is, defined in terms of economics- notably value in exchange in the marketplace. [6] To move away from this in terms of design, construction, and ongoing management and to place people and the community at the heart of decisions means re-thinking the long-held supremacy of economic return on investment. To shift the mindset to a social return on investment is not easy, with Watson et al. (2016) concluding that, inconsistency of the

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[5] The Triple Bottom Line, which balances economic, social and environmental factors in decision making is widely attributed to Elkington (199)

[6] IVSC (2016) provides the most widely adopted definition of market value as being Market Value is **the estimated amount for which an asset or liability should exchange on the valuation date between a willing buyer and a willing** seller in an arm's length transaction, after proper marketing and where the parties had each acted knowledgeably, prudently and without compulsion.

financial metrics and data adopted, lead to concerns as to the effectiveness of such measures in truly reflecting the value to the building user.

If such metrics cannot do this at the level of the building user, how can they assess social value to the wider community? UKGBC (2021), in attempting a high-level definition, attempt to do this by placing emphasis on the impact of the building on all stakeholders and by placing the needs of the local community at the heart of the design process. Further, arising partly from the early experiences of Covid-19 and the resultant challenges and anticipated demand changes in the way and locus of work, has come renewed interest in placemaking. IPUT/Arup (2020) have sought to address this through the idea of workplacemaking with the aim of 'recalibrating' the city environment by deeper consideration of the spaces between buildings – such as streets, squares, and green space - as integral to development.

The IPUT/Arup report focuses on new build but translates equally to retrofit projects. If building retrofit schemes can clearly articulate create 'permeable' buildings and places (see for example Pafka and Dovey, 2017) according to the principles laid down by Jacobs (1961) then a pathway to social - as well as economic – value is created. Relating this beyond the individual building, to consideration of local areas and city level is argued by Eames et al. (2014) to be critical to achieving 2050 climate targets.

In summary, it is contended to, for the fulfilment of retrofits which provide social value returns, schemes need to take an all-embracing view of who the stakeholders of a builder are and, through retrofit, can be. By adoption of, for example, exploring multi-uses which allow and encourage permeability within and beyond buildings will allow a sense of community that can engender vibrancy, and inclusivity and, achieve not just a social but an economic dividend. As discussed in the section below, the retention of, and investment in heritage buildings, can often be core to the enhancement of social value.

### 2.6 Demolition v preservation v conservation

#### 2.6.1 The principle

The debate about demolition against refurbishment and retrofit has been introduced above with the argument that demolition results not just in waste of resources, especially embodied carbon, but that it can have a negative impact on a sense of place. Nonetheless, even whilst supporting the notion of circularity and maximum re-use, there are times when demolition may be the only solution; the building may be structurally unsound or its location such that no new alternate purpose that is economically or socially viable is appropriate. A balanced approach, but one favouring retrofit is advocated as argued by Sayce et al. (2004) and more recently RIBA.[7]

Further, as climate change hastens, unless appropriate government led protections schemes have taken place, risks of flood, fire or storm may render the location no longer appropriate to support human activity. Even, if protection has taken place against some hazards, the prospects of extreme heat may not be capable of mitigation in some locales and may loss o the building – or even the settlement – inevitable and appropriate.

But, in reaching decisions, environmental and social factors are critically important considerations if sustainable development goals are to be recognised and progress towards them achieved. The quantum of regulatory responses to ensure that such a 'triple bottom line' approach is adopted

[7] See comment on section XXX above.

through planning and regulatory processes varies from country to country. Regardless of the regulatory controls and given the embodied carbon in buildings, the initial approach, from a climate change perspective, must be to seek a solution that does not involve demolition. But in the past has normally been taken on 'single – line' economic criteria: simply which is the most profitable route to follow?

In addition to the potential, and actual, impact of climate change factor and other environmental considerations, Covid-19 has underscored the need for buildings to provide healthy environments that promote well-being. In the commercial setting this includes technology solutions such as ensuring high air quality air; domestically, the pandemic has produced a heightened awareness of the role of outdoor space and study spaces for mental wellbeing and work productivity.

A further dimension in the argument is the extent to which decision-making as to the future of any asset should be determined by historic connection: should it be preserved, conserved, or allowed to change to maximise economic and environmental benefit? In some cases, the case for preservation is paramount: who would look to re-use or re-purpose some of the major monuments in the world? But the argument between preservation, that is retaining in existing form for posterity and conserving, which allows of controlled and limited change, is important. Both solutions can bring economic benefit: through tourism for example, but they can come into conflict where the move to achieve reduced carbon use if is concerned. Accommodation is required in order not to destroy the cultural and historic connections whilst achieving resource use reduction. An example of how this is being attempted in the UK is in relation to minimum energy standards which are imposed on all let buildings. In the case of protected historic buildings and those in conservation areas, the standard is imposed – but only to the extent that that the energy upgrade would not result in a loss of the historic features that have given rise to protection.

### 2.6.2 Conservation of Buildings under pressure: examples

We finish this section with a few examples of where buildings have been 'saved' to a smaller or lesser extent; the first two are old examples to illustrate that the principles have long been recognised; the latter two are recent. All are from the UK, which is believed to have the oldest built stock in the world and, hence, offers may examples of where retrofit has trumped demolition.

2.6.2.1 Docklands, London, UK: industrial to residential

London Docklands was, until the early 1980s, a collection of many buildings associated with the import and export of goods and materials to and from the UK.[8] But from prosperity and growth in the nineteenth century, increases in the size of commercial ships meant that they could no longer gain access so far up rived and a new seaport further downstream at Tilbury, led to the loss of their use by the 1970s. But whilst for years the old docks stood derelict, growth of economic, especially banking activity, overspilled the capacity of the City of London, and many parts of the old docklands became the potential for, and ultimate development of, a new business district – Canary Wharf leading to large-scale destruction of buildings and communities, despite the intention to retain where possible. But it was in the areas outside the new hub where buildings stood empty: economic values did not justify demolition and redevelopment. But, over time, many of those derelict buildings, which for lack of profitability, avoided the wrecking ball, subsequently found new life, not as warehousing - but as desirable flats close to the new business centre and well-served by public investment in public transport links. A case study of some such buildings is presented in Sayce et al. (2004). In respect of sustainability, the embodied carbon in the existing structure and fabric of the

[8] For a brief history seehttps://www.royaldocks.london/articles/a-history-of-the-royal-docks

buildings is very positive. Given the new uses energy and water demands will have changed and new services should ensure more optimum consumption.

2.6.2.2 Rodboro Buildings, Guildford UK: industrial to leisure.

A further example of conservation against all odds is presented by the Rodboro Building in Guildford UK. Reputed to be the UK's first car factory, its use changed many times before it become redundant and neglected. However, despite being listed as of historic importance, a lack of economic purpose placed the building at severe risk. It was only through determination and a sense of local history that demolition was averted, and it now trades successfully as a pub.[9] This is a further example of where full refurbishment and change of use has retained history, and saved the embodied carbon and other resources; however, it was achieved for cultural and social reasons rather than any notion of the need for circulatory.  Today, the desire to retain to prevent linear consumption should be an additional driver towards preferring retrofit and re-purpose over demolition

2.6.2. 3 Springfield, Wolverhampton UK: from Brewery to University 'super campus'

The old Springfield Brewery[10], constructed in the latter part of the 19th century is yet another example of a building which had lost value in its original use; it finally ceased operating in 1991. Subsequently it was damaged by fire and looked set to be demolished for a housing scheme.  But in much the same way as many other buildings survived, a poor economic climate rendered this unprofitable and, with the growth in  the university sector and a far greater awareness of the role of heritage, it has under gone a major programme of renewal and retrofitting, leading to its opening in 2015 as a university campus where  and adjacent new building is planned as home to the National Brownfield Institute[11], which will secure the long-term of the old brewery and create a new- but very different – community of place.

2.6.2.4 Entopia Buildings, Cambridge UK: from Telephone Exchange to  Sustainability Centre (NEEDS FINISHING)

The most recent case study offered, which demonstrates how far thinking has come is the Entopia Building Cambridge, which is billed as being a 'world-first sustainable office retrofit' [12]to home Cambridge University's Institute for Sustainability Leadership.  The original use obsolete, the building is not just another example of re-use: it is being retrofitted to full zero-carbon in use standards, appropriate for its intended new use.

**2.7 Conclusion**

This chapter has defined what is meant by a resilient building, distinct from an 'environmentally' friendly' or 'sustainable' one. Not only is retrofit a necessity, due to the climate imperative, but that it is a desirable social outcome, conserving as it does, the maintenance of place, memory, and culture. It has debated what happens when place and community are lost for example, as in the London Docklands or at Barangaroo in Sydney, Australia. The chapter has explored the extent to which retrofitting to preserve – or conserve - the social value of the building and its context is a philosophical, economic, or legislative matter. It considered the ways in which a resilient retrofit differs from any normal cyclical undertaking to bring a building back to standard - including the issue

[9] This case study is written up in Sayce et al. 2004 and a short history can also be found at https://www.guildfordsociety.org.uk/rodboro.html.
[10] For a brief history see https://www.wlv.ac.uk/university-life/our-campus/springfield-campus/heritage-of-springfield/
[11] https://investwm.co.uk/2020/12/14/17-5m-national-brownfield-institute/
[12] https://www.cisl.cam.ac.uk/about/entopia-building

of decisions around the redevelop/retrofit decision. It considered the timing at which retrofitting takes place and distinguishes ‘deep’ and ‘light’ retrofit approaches. The chapter has emphasised where the business-as-usual approach is lacking and outlines the radical and drastic changes needed to our current conceptual understanding to deliver the changes needed.

In essence, retrofits range from minor to major (Wilkinson and Remoy 2018). Some owners may prefer to engage in an approach of little and often rather than deep or major retrofits. Owners will consider the costs, benefits and pay back periods involved in the available or proposed measures. Whilst attempts have been made to assess what may constitute an optimal time frame (see for example, Senel Solmaz et al, 2018) it is far from a case of ‘one size fits all’.

For example, if a building is tenanted and the owner wants to retain the tenants, they may engage in measures that cause minimal disruption to occupation, but that improve the tenant experience either through lower operating costs, greater comfort and/or improved reputation through occupation of an improved building. This is often the case with residential social landlords, for whom tenant well-being is a high priority, although as far as possible they may will to undertake energy improvements ‘in-cycle’ meaning when other renewals (e.g. kitchen/bathroom fittings require replacement). In respect of resilience, retrofits may enable owners to enhance building resilience to shocks and stresses as our knowledge and understanding of them evolves.

Retrofit will always be required: whereas a building envelope can normally be expected to outlast its economic usefulness in its existing use, building services typically have a life cycle of only around 25 years or so before replacement is required- and they may become inefficient in terms of performance long before this. At this stage, tenants may need to vacate part of all a building, and it can be a good time to consider other improvements and/or repairs to the building fabric and envelope-. Other more significant sustainability and resilience options can be considered at this ‘in-cycle’ stage. Some retrofit measures will also enhance capital value of the building, however the gain may less than the cost. But to protect value and prevent installation of retrofit measures, although they may enhance capital value, will not necessarily produce a capital gain greater than the cost. If this is the case, they may face a very real risk of the building becoming ‘stranded in value terms (or a discussion of this see Muldoon-Smith. and Greenhalgh (2019). But the investment is one way to help reduce such risks (see Wilkinson and Sayce, 2020).

Finally, the chapter explored the extent to which retrofitting to preserve – or conserve - the social value of the building and its context is a philosophical, economic or legislative matter. Whilst this has long been the case, and illustrations of building survival have been quoted, heightened awareness of climate change and the lens of Covid-19 have helped some responsible building owner to seek to create truly remarkable retrofits which meet the very highest environmental ambitions.

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