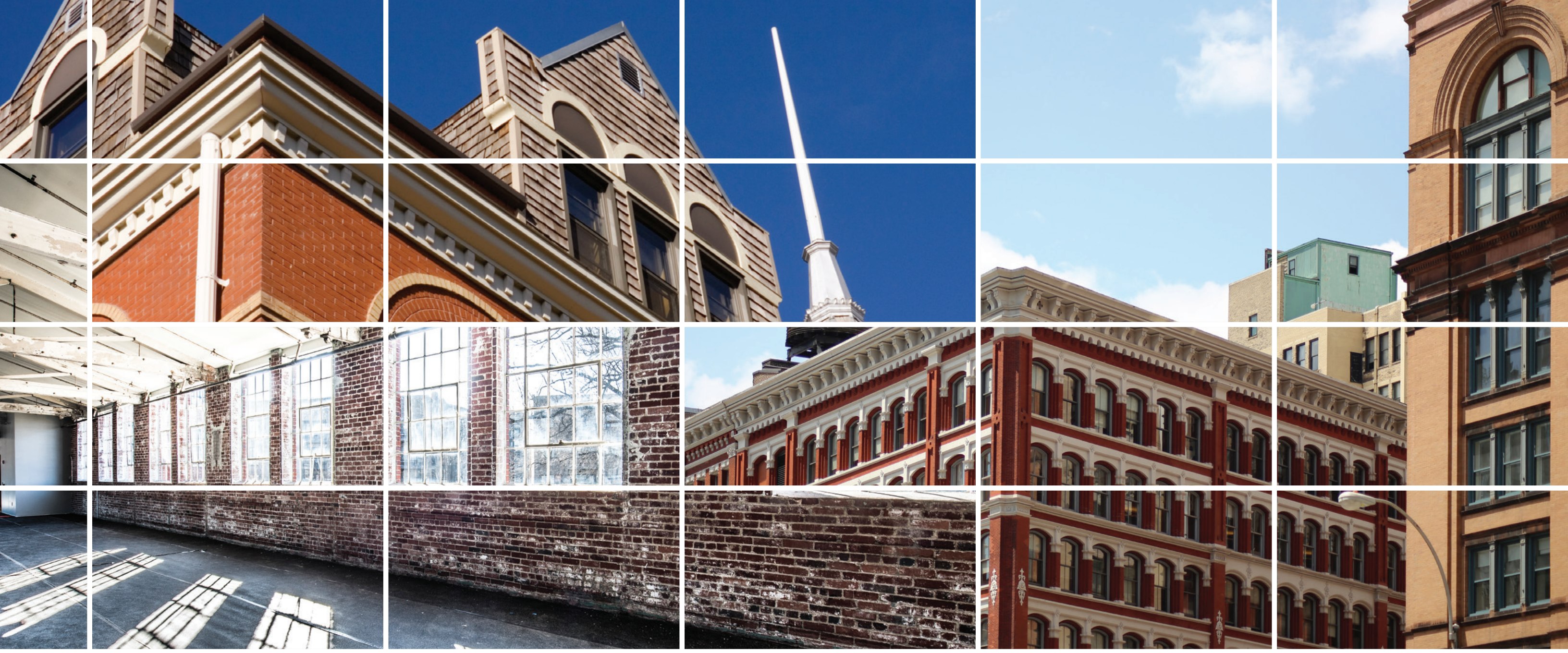

Good Practice Existing Buildings Guidelines

INTERNATIONAL
BUILDING
QUALITY CENTRE

April 2025

Produced with support from the International Code Council, Technical University of Munich, University College London, Lovegrove & Cotton, Southern Cross University, University of Canberra, University of Nairobi, and the Massey University, Western Sydney University

Table of contents

Disclaimer

The information provided in this guideline is for general informational purposes only. It does not constitute legal advice. For specific legal advice related to building regulations and compliance, please consult a qualified construction lawyer.

1. INTRODUCTION

The Good Practice Existing Buildings Guidelines (the Guidelines) has been developed to establish a suite of key principles and strategies to aid in maintaining occupant health and safety of existing buildings, achieve ongoing performance throughout their design life and respond to problems associated with resource depletion and carbon emissions.

With a few exceptions, the objectives of modern building codes focus on new buildings, new building work and change of occupancy that necessitate higher standards than for those that already exist. This has the potential to leave the owners and occupants of existing buildings to their own devices, subject to a patchwork of regulatory, facility management and educational measures aimed at familiarizing them with an asset that, if not properly maintained, can undermine features designed to enhance health and safety, as well as diminish the service life of the building.

This becomes increasingly important as the built environment witnesses a shift to denser urban environments, represented by an increasing number of high-rise residential and mixed-use developments, which are more complex to operate, yet may be under the stewardship of inexperienced collective ownership arrangements.

As of 2021, the global stock of existing buildings covers approximately 252.7 billion square meters,[1] with projections to increase by 230 billion square meters by 2060,[2] especially in regions like India, Africa, Latin America, the Middle East and Asia. This represents new global building stock growing at an average annual rate of approximately 2.0 percent.

While existing buildings contribute significantly to the global economy - both through the construction multiplier effect and the value of the physical asset - they are also major consumer of energy and, as a result, substantial sources of CO2 emissions.

Retrofitting and adapting existing buildings will significantly reduce the environmental impact of the construction sector by using the inert built grey energy and allowing continued use of the building, thereby minimizing the secondary costs associated with temporary alternatives.[3] The International Energy Agency (IEA) emphasizes the importance of retrofitting and repurposing existing buildings to improve energy efficiency[4] as many current buildings will still be in use by 2050.

This approach also aligns with the concept of sufficiency, where buildings serve not only as material possessions or tradeable assets, but foster social cohesion, employment opportunities, access to infrastructure, safety, culture and community life.[5]

While the reuse and repurposing of buildings supports the triple bottom line - delivering economic, environmental and social benefits - existing buildings are often complex, characterized by large floor areas, high population densities, significant height and locations that can make them particularly vulnerable to natural hazards. Therefore it is important to remember that occupant health and safety are paramount in the ongoing use, maintenance and repurposing of buildings.

1 United Nations Environment Programme (2021)
2 Buildings and Climate Global Forum (2024)
3 Gschoesser, et al (2016)
4 International Energy Agency (2020)
5 Building Performance Institute Europe (2024)

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2. PROBLEM

Many existing buildings, which are often complex in nature and high-risk, are not properly maintained. This can compromise the health and safety of occupants, as well as the general public.

Inadequate construction durability and maintenance, or functional obsolescence, can also lead to premature building replacement. This stock represents a substantial carbon sink.

Both scenarios present distinct challenges and opportunities. When it comes to maintenance, the focus is on preserving the building's design intent, lifespan and performance. In obsolescence, when a building is no longer in use, there is an opportunity to refurbish or repurpose the structure.

3. PURPOSE OF THE GUIDELINE

3.1 Objective

- Establish principles to ensure that once constructed, buildings maintain occupant health and safety, achieve ongoing performance and enable the realization and possible extension of their design life.

3.2 Scope

- The Guidelines apply to buildings designed for human occupancy and exclude civil infrastructure, like roads and ports.

3.3 Audience

- The primary audience for these guidelines is building owners, owners’ corporation arrangements and facility managers. A secondary audience comprises regulators and contractors engaged in the maintenance, refurbishment and repurposing of existing buildings.

3.4 Assumption

- Modern building codes will continue to evolve and improve the stock of new buildings, addressing issues like safety, amenity, sustainability, design life and durability.

4. GENERAL DEFINITIONS

- Existing Buildings: Buildings already constructed and occupied.
- Duty Holder: Is a person or organization who has a statutory duty under relevant laws and regulations.
- Maintenance: Actions taken to preserve a building’s function and appearance.
- Retrofitting: Upgrading existing buildings to improve performance.
- Circular Economy: System focused on recycling, repurposing and reusing resources.
- High-Risk Buildings: Buildings that, through a combination of established criteria, represent an elevated potential to adversely affect the health and safety of people arising from an impactful event.

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5. ANALYSIS

5.1 Responsibilities

- It is essential that there is an awareness of the associated consequences of not conducting regular inspections of high-risk buildings and acting upon any recommendations, particularly those relating to health and life safety.
- The cost of maintaining buildings correctly can be high. The cost of not doing so can be much higher.

Governments and their delegated agencies hold overall responsibility, with authorities having jurisdiction and owners' or occupiers' corporations being Duty Holders directly accountable for enforcement and compliance.

5.1 Structural and Fire Challenges

- Complexity: Buildings integrate critical life safety systems along with innovative designs and materials, requiring expert knowledge of both the building as a whole and its individual sub-systems, as well as regular maintenance of all components.
- Awareness: Duty Holders for the ongoing performance of a building need to be aware not only of their statutory responsibilities, but also of the building's features, the emergence of new risks remove second "new risks" (either introduced or developed during the life of the building or through any refurbishment/repurposing) and maintenance regime. A critical component of this awareness is a thorough and holistic understanding of the building and its various sub-systems.

  The most effective way to ensure this level of awareness it through a comprehensive safety case, which also serves as a record of any modifications made to the building and its components-allowing for the assessment of their impact on other elements of the structure. This is different from a maintenance manual/owner's manual as its purpose is to demonstrate how the building's various systems support each other and function separately and as a whole.
- Maintenance: Like any other complex assembly of products, buildings require both planned preventative and reactive maintenance. Typically, complex buildings are subject to Operation and Maintenance Manuals, which provide for the maintenance of the building, including all plant and equipment. Within this arrangement, structural and fire safety in particular require regular and expert attention.

5.3 Financial and Regulatory Challenges

- Energy Consumption and Emissions: Buildings account for a significant portion of global energy consumption and CO2 emissions. Such consumption/emissions occur in three phases:

  (1) Cradle-to-grave grey energy, namely embodied carbon - encompassing the carbon embedded in materials and products, as well as the energy used in their manufacturing, transportation throughout the supply chain and the construction of the building.

  (2) During the operation of the building.

  (3) In the end-of-life phase, namely when the building and/or significant elements of it become technically obsolete and require destruction or disposal.
- Retrofitting and Decarbonization: Substantial investment and policy support are required for energy-efficient retrofitting.
- Financial and Organizational Barriers: High costs and lack of financial incentives hinder building maintenance and upgrades.

- Regulatory Oversight: Enhance regulatory efficiency through digital tools.
- Consequences for Non-Compliance: Establish clear consequences for failure to maintain adequate records such as a safety case, fire safety strategy (see 7(3) below) and/or a refusal to maintain buildings.
- Role of Body Corporate: Ensure skilled personnel for maintenance tasks and compliance with safety standards.
- Heritage Buildings: Balance retrofitting with preservation of historical and cultural features.
- Education and Training: Emphasize education and training for owners, occupiers and contractors on building maintenance.
- Health and Safety Education: Mandatory education on health, safety and property maintenance.

6. KEY GUIDELINE PRINCIPLES

- Policy Focus: There should be a public policy focus on maintaining the safety of existing buildings as well as encouraging their repurposing to promote whole of life performance.
- Retrospectivity: Application of contemporary codes and standards for new buildings should not be applied retrospectively, except in limited and transparently justified circumstances for critical life safety measures[6] (note: this does not prevent voluntary or incentivised uptake).
- New Risks and Hazards: Continually be vigilant and monitor the existence, development or introduction of new risk and/or hazards. Actions to address one objective maybe detrimental to other objectives.
- Strong Safety Culture: Importance of taking the time necessary to get the design and construction for refurbished and repurposed buildings, as well as substantial maintenance of existing buildings, completed correctly.
- Fire and Structural Safety: Despite the importance of reducing carbon emissions through the refurbishment and repurposing of existing buildings, ongoing fire and structural safety remain the paramount concern.
- Fire Safety Strategy, Safety Case: A fire safety strategy and safety case should be created, if not existing already, and used to ensure that owners and their experts, and in turn the responsible authorities, have a thorough understanding of the building and can be satisfied of its compliance.
- Owner's Manual: Building owners should have comprehensive documentation for effective maintenance. Annexure 1 gives an example of the structure and the essential contents of an owner's manual.
- Local Authorities: Empower local councils or authorities having jurisdiction to act on unsafe structures.
- Digital Information Management Use of digital tools (see 7(6) below) ensures accuracy in the building's safety case and supports adequate maintenance. Essential maintenance information should also be stored digitally.
- Regular Inspections for Critical Systems: Ensure performance standards.
- Regulatory Oversight: Enhance regulatory efficiency through digital tools.
- Consequences for Non-Compliance: Establish clear consequences for failure to maintain adequate

6 Hertle, R. (2023)

records such as a safety case, fire safety strategy (see 7(3) below) and/or a refusal to maintain buildings.

- Role of Body Corporate: Ensure skilled personnel for maintenance tasks and compliance with safety standards.
- Heritage Buildings: Balance retrofitting with preservation of historical and cultural features.
- Education and Training: Emphasize education and training for owners, occupiers and contractors on building maintenance.
- Health and Safety Education: Mandatory education on health, safety and property maintenance.

7. IMPLEMENTATION STRATEGIES

7.1 Establishing a Regulatory Framework

1. Develop Comprehensive Legislation: Government agencies should craft and enact laws mandating the maintenance and safety of existing buildings, ensuring alignment with contemporary standards for durability, energy efficiency and resilience.
2. Mandatory Inspections: High-risk buildings should undergo mandatory inspections to ensure safety and maintenance (high-risk buildings can be determined using a methodology based on the IQBC's risk-based building classification and inspection guideline).[7]
3. Fire Safety and Evacuation: A fire safety strategy needs to be established and properly maintained for existing high-risk buildings, including when subject to refurbishment or repurposing.[8,9] : A fire safety strategy ensures that the building's component parts and systems all work together to ensure a compliant building from a fire safety perspective. Absent a fire safety strategy, there is no means of understanding whether the building is compliant from a fire safety perspective or not. The fire safety strategy determines the evacuation strategy for the building, in that, depending on the combustibility of materials used and estimated time to failure, certain evacuation strategies (such as stay put or variants on stay put) will not be viable. Any evacuation strategy must cater for the vulnerable or those with disabilities.
4. Statement of Safety: Regulate as a statutory requirement in relation to the substantial refurbishment or repurposing of high-risk buildings,[10] that a statement be provided from a senior manager of the principal designer, that all reasonable steps have been taken to ensure that on completion, the building as designed will be safe.[11]
5. Create Enforcement Mechanisms: Implement robust enforcement measures, including regular inspections, penalties for non-compliance and incentives for proactive maintenance.
6. Integrate Digital Tools: Utilize digital platforms like Building Information Modelling (BIM), Building Management System (BMS) or Computerized Maintenance Management System (CMMS) to maintain and access critical building data, ensuring efficient oversight and transparency. [12,13,14]
7. Digital Twins: When retrofitting and/or updating an existing building, provisions for developing a digital twin of the building should be made. This will ensure a comprehensive record of the changes to a building and facilitate the monitoring of performance, energy consumption and maintenance.

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7 UNDRR (2023)
8 bid
9 The Rt Hon Sir Martin Moore-Bick, Ali Akbor,OBE, Thouria Istephan (2024)
10 International Building Quality Centre (2024)
11 Ibid
12 Lee, H. H. Y., & Scott, D. (2009)
13 Chong, H. Y., Lee, C. Y., & Wang, X. (2017)
14 Hauashdh, A., Jailani, J., & Rahman, I. A. (2022)

7.2 Mandatory inspections and Maintenance

1. Regular Inspections: Establish mandatory inspection schedules for different building types, focusing on structural integrity, life safety systems and critical functions. Certified professionals should conduct these inspections to ensure thoroughness and compliance.[15,16,17]
2. Maintenance Plans: Require building owners to develop and submit detailed maintenance plans, including timelines for routine checks and repairs.[18,19]
3. Qualified Professionals: Ensure inspections and maintenance are conducted by certified professionals to prevent unqualified work that could compromise safety.[20]
4. Maintenance Guidelines: Clear guidelines need to be developed to prevent damage from unqualified workers or tradespeople unfamiliar with characteristics of older building stock.

7.3 Education and Training Programs

1. Contractor Training: Professional training organizations, trade schools and industry associations should develop and deliver compulsory training programs for contractors and maintenance personnel. These programs should cover modern building maintenance practices, safety standards and energy efficiency upgrades.[21]
2. Owner Education: Government agencies, local councils and non-profit organizations should provide educational resources and workshops for building owners. These resources should emphasize the importance of regular maintenance and the benefits of compliance with updated guidelines.[22]
3. Public Awareness Campaigns: Government bodies, industry associations and environmental organizations should collaborate to launch public awareness campaigns. These campaigns should highlight the economic, environmental and safety benefits of maintaining existing buildings and encourage community engagement and participation in building maintenance efforts.[23]

7.4 Financial incentives and Support

1. Incentive Programs: Government agencies should create financial incentives such as tax credits, grants or low-interest loans to encourage building owners to invest in maintenance and energy efficiency upgrades.
2. Public-Private Partnerships: Foster collaborations between government bodies and private sector stakeholders to fund and promote building maintenance initiatives.[24]
3. Insurance Adjustments: Encourage insurance companies to offer lower premiums for buildings that meet or exceed established maintenance and safety standards

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15 Bortolini, R., & Forcada, N. (2018)
16 Flores-Colen, I., & de Brito, J. (2010)
17 Australian Building Coded Board (2020)
18 Khalid, E. I., Abdullah, S., Hanafi, M. H., Said, S. Y., & Hasim, M. S. (2019)
19 Madureira, S., Flores-Colen, I., de Brito, J., & Pereira, C. (2017)
20 International Code Council (2021)
21 Hauashdh, A., Jailani, J., & Rahman, I. A. (2022)
22 Ibid
23 Ibid
24 Ibid

7.5 Policy Focus and Local Authority Roles

1. Localized Policies: Tailor policies to address specific regional challenges and needs, ensuring they are feasible and effective within local contexts.[25,26,27]
2. Empower Local Councils: Grant local authorities the power to act on unsafe structures, providing them with the resources and authority needed to enforce maintenance and safety standards.[28]
3. Community Engagement: Subject to safety requirements advised by experts for the building in question, involve local communities in decision-making processes to ensure policies reflect their needs and priorities.[29] As fire safety is building specific, caution is needed when considering generic decisions/ schemes.

7.6 Building Data Generation

1. Existing Documentation: Analyze the existing building documentation to assess its adequacy, establish the fundamental design principles, identify the structural concepts and evaluate the technologies applied to the facade and all building systems - such as mechanical, electrical, heating, ventilation, air conditioning (HVAC), as well as information on materials and products used.
2. Reality Check: Double check the information taken from the building documentation by comparing these with results of on-site inspections and deriving necessary measurements to gain information on the missing or contradictory pieces.
3. Information Generation – Structural: Strategies for setting up concepts for structural remedies, enhancement and adaption of existing buildings must reach far beyond the elementary task of comparing the obvious with the requirements of the lawfully established set of rules and regulations. It is necessary to analyze the built structure in depth and establish the actual structural properties through bespoke tests and evaluation schemes. These form the basis for the retrofitting design.[30]
4. Information Generation – Fire: As stated above, in order to ascertain whether a building is safe and compliant, a Fire Safety Strategy must be prepared (if there is not one already in existence) which considers each element of the building, including its current active and passive fire safety features, establishes the fire safety of the existing building in order to understand how the design of the refurbishment or redesign of the fire safety strategy is to be achieved.
5. Information Generation – Decarbonization: Existing buildings represent a sink of embodied carbon. Having determined the practicality of utilizing an existing building through setting up strategies for structural and fire safety remedies, analysis of the carbon profile for reusing, repurposing or deconstructing a building to enable the recycling of its parts is necessary. This will help verify the viability of extending a building's service life through comparison with the profile of building new, including establishing what additional energy efficiency measures can be accommodated through refurbishment and reuse.

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25 Lee, H. H. Y., & Scott, D. (2009)
26 Bortolini, R., & Forcada, N. (2018)
27 Khalid, E. I., Abdullah, S., Hanafi, M. H., Said, S. Y., & Hasim, M. S. (2019)
28 bid
29 Hauashdh, A., Jailani, J., & Rahman, I. A. (2022)
30 Unpublished Guidance on determining and assessing the building´s structural properties

6. Information Generation – Information and Communications Technology (ICT): As with other utilities, ICT represents critical infrastructure that, in the digital age, is important in servicing occupant needs and the operational performance of buildings. This is particularly the case for large and more complex buildings, including multistory residential buildings. To allow these functions to be reliably performed, provision for ICT pathways (including vertical risers) and spaces (including equipment rooms that avoid a single point of failure), equipment room and an alternative building entry point, need to be accommodated.[31]

7.7 Documentation and Data Management

1. Comprehensive Documentation: Mandate the creation and maintenance of detailed building documentation, including original construction data, maintenance records and inspection reports.[32,33]
2. Digital Repositories: Establish centralized digital repositories where building data can be stored and accessed by relevant stakeholders, ensuring ongoing compliance, maintenance and continuity.
3. Standardized Reporting: Develop standardized reporting formats for maintenance activities and outcomes to streamline data collection and analysis.[34]

7.8 Heritage Building Considerations

1. Balanced Retrofitting: Develop guidelines for retrofitting heritage buildings that balance modern energy efficiency standards with the preservation of historical and cultural features.[35]
2. Special Exemptions: Provide exemptions from onerous retrofitting standards for heritage buildings, while still encouraging feasible upgrades to improve their safety and sustainability.
3. Funding for Preservation: Allocate funding specifically for the preservation and maintenance of heritage buildings, recognizing their cultural and historical significance.

7.9 Resilience and Circular Economy

1. Climate Resilience Upgrades: Promote the retrofitting of existing buildings to enhance their resilience to extreme weather events, focusing on areas prone to climate-related risks.[36]
2. Accessibility and Egress: Improving accessibility and egress in existing buildings to enhance safety and support aging in place may require the introduction of incentives and the availability of flexible standards. These would allow for technical building solutions that are less stringent than those for new construction, while also recognizing what is realistically feasible. (i.e. both constructable and cost effective).
3. Circular Economy Practices: Encourage the adoption of circular economy principles in building maintenance, emphasizing recycling, repurposing and reusing materials.[37,38] Substantial refurbishment and repurposing of existing buildings needs to comply with contemporary codes and standards.
4. Sustainability Standards: Integrate sustainability standards into building maintenance guidelines, ensuring existing structures contribute to broader environmental goals.[39]

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31 Adapted from Australian Building Codes Board (2006)
32 Australian Building Coded Board (2020)
33 International Code Council (2024)
34 Bortolini, R., & Forcada, N. (2018)
35 Ibid
36 UNDRR (2023)
37 DGNB (2019)
38 Hauashdh, A., Jailani, J., & Rahman, I. A. (2022)
39 Bortolini, R., & Forcada, N. (2018)

7.10 Monitoring and Evaluation

1. Regular Review: Conduct regular reviews of the guidelines and their implementation to ensure they remain relevant and effective in addressing emerging challenges.
2. Performance Metrics: Develop performance metrics to evaluate the success of maintenance programs and the impact of implemented strategies on building longevity and safety.[40,41]
3. Stakeholder Feedback: Collect and incorporate feedback from stakeholders, including building owners, contractors and local authorities, to continuously improve guidelines and practices.[42,43]

By adopting these implementation strategies, we can ensure the effective maintenance and preservation of existing buildings, maximizing their economic, environmental and cultural value for future generations without compromising their safety.

8. CONCLUSIONS

- Policy and Regulation: Establishing robust guidelines and policies is essential for the preservation and enhancement of existing structures. Effective regulatory frameworks, mandatory inspections and maintenance plans are necessary to ensure the safety, durability and performance of buildings. Empowering local authorities and integrating digital tools for information management can enhance regulatory oversight and efficiency. Additionally, financial incentives and support for building owners can encourage investments in essential maintenance and energy efficiency upgrades.
- Economic and Environmental Impact: Retrofitting existing buildings is crucial for global sustainability goals. Given the substantial portion of global energy consumption and CO2 emissions attributable to buildings, improving the energy performance of existing structures offers significant environmental benefits. Retrofitting not only extends the lifespan of buildings but also enhances their resilience to extreme weather events and preserves their historical and cultural value.
- Challenges in Building Longevity: Implementing thoughtful design and maintenance practices can significantly extend the lifespan of buildings. Addressing issues related to durability and maintenance is crucial for preventing premature building replacement. By incorporating circular economy principles, such as recycling, repurposing and reusing materials, the construction industry can reduce the need for new resources and minimize waste.
- Adopting or adapting these principles and strategies can preserve the life safety for occupants and help protect the value of the owners' asset through targeted and responsible maintenance and, where necessary, upgrades. Ensuring the effective maintenance and preservation of buildings also maximizes their economic, environmental and cultural value for future generations, contributing to achieving global emissions reduction goals and enhancing the overall resilience of the built environment.

40 Australian Building Coded Board (2020)
41 Madureira, S., Flores-Colen, I., de Brito, J., & Pereira, C. (2017)
42 Lee, H. H. Y., & Scott, D. (2009)
43 Ibid

GUIDELINES DRAFTING COALITION MEMBERS, AUTHORS, AND CONTRIBUTORS

Southern Hemisphere Chair

- Professor (Adj) Kim Lovegrove, MSE, RML. Chair IBQC, co-author and draftsperson
- Neil Savery, Managing Director, International Code Council Oceania, co-author and principal draftsperson
- Christina Knorr, Managing Director, CJK Fire & Safety Pty Ltd, contributor and editorial
- Professor (Adj) Robert Gordon Whittaker, AM, FRSN, FAIB, contributor
- Professor Charles Lemckert, Professor of Engineering and Discipline Chair of Engineering and Information Technology, contributor
- Chelsea Kalman, Civil Engineering Student at Southern Cross University, contributor

Northern Hemisphere Chair

- Professor Robert Hertle, Germany. Honorary Professor, Technical University of Munich, co-author, and draftsperson
- Dr Brian Ashe, Managing Director, BASIC Expert UK LLP, co-author and draftsperson
- Professor Juergen Felix, Germany. Chair, Concrete Structures, University of Innsbruck, contributor
- Beth Tubbs, Vice President of Codes, International Code Council, contributor

RESEARCH AND DEVELOPMENT

- Chelsea Kalman, Civil Engineering Student at Southern Cross University

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ANNEXURE 1:

Building Owner's Manual

Contents

Footnote 28: Unpublished Guidance on determining and assessing the building´s structural properties

Disclaimer

The information provided in this footnote is for general informational purposes only. It does not constitute technical advice. For specific technical advice related to the maintenance, refurbishment or repurposing of an existing building, please consult an appropriately qualified and registered professional.

1. General Principles

1.1. By determining and assessing a building´s structural properties, a reliable and robust basis can be established for all further considerations, whether these aim at preserving existing buildings only or a fundamental refurbishment and possible extension of those.

1.2. The Right of Continuance/Grandfathering only extends as far as the future use of the building where it does not differ from the past, i.e., load regimes, exposition to climatic actions, chemical and/or environmental issues and no structural insufficiencies are detected or known.

1.3. Applying up-to-date technical rules and regulations to existing structures will often lead to contradictions and discrepancies that are not inevitable or an indicator for structural weaknesses.

1.4. Determining the actual structural properties of existing buildings, provides the basis for a bespoke design and verification concept, using the general principles for structural integrity and establishing the socially accepted probability of failure.

1.5. It is essential to understand that the establishment of the structural properties of an existing building has to occur having the profile and the purpose of its intended future use in mind.

2. Existing Documents

2.1. The first and primary source for assessing the structural properties of an existing structure are Inventory Documents, including:

- As-Buit-Drawings
- Structural analyses
- Permits
- Expertise statements for special purposes

2.2. Of comparable importance is information about structural alterations/modifications, such as core drillings or wall breakthrough, affecting the local or global load-paths and capacities.

2.3. Besides the building-specific documents, another crucial source of information for establishing the structural properties of the building at hand are the technical rules and regulations valid at the time of design and erection of the structure.

2.4. It is also worthwhile to consult secondary sources to understand and integrate the basics of the design philosophy and the execution methods and quality of the era the building was built.

3. In-Situ Investigations

3.1. Double-checking the information gained throughout the study of the existing documents or, if the existing documents aren´t sufficient, in-situ investigations are a must.

3.2. Depending on the depth of the information gained by analyzing the inventory documents, the in-situ inspections may differ in character from random sample spot checks to full-blown inventory covering the geometrical as well as the material side.

3.3. Special attention has to be paid in checking the dimensions, structural systems and the structural amendments/modifications introduced during the building's life-span and the materials used against the information derived from the inventory documents.

3.4. The set of data gained, concerning the geometrical properties as well as the materials, has to fulfill statistical requirements to allow for establishing limit-state-relations as one feature of the above-mentioned bespoke design and verification concept.

3.5. Non-destructive and destructive testing methods, both on-site as well as in the laboratory, are to be used in order to gain this information.

4. Load- and Exposition-History of the Building

4.1. Unearthing the load-history of the building and judging it against the structural quality information gathered through the in-situ investigation, allows for identifying possible structural degradations and, more importantly, the underlying reasons.

4.2. The exposition of the existing building throughout its lifespan against mechanical, chemical and climate-related actions is of major importance for an appropriate estimation of its structural qualities, as structural degradation (e.g., ageing, corrosion, embrittlement, etc.) is, with the exception of fatigue phenomena, closely linked.

4.3. Integrating the load and exposition related information, and combining these with the established material properties, allows for deriving degradation-functions for both single structural components and the building as a whole, as a basis for assessing the remaining safe lifespan and/or the determination of necessary structural interventions to guarantee a safe service life.

5. Updating the Structural Information

5.1. Based on the results of in-situ investigations combined with the load and exposition history, the structural information of the existing building has to be updated.

5.2. At best, this can be done by amending the existing documentation, but in most cases a complete set of new documents (As-It-Is-Documents) must be produced.

5.3. These documents must include all information and data relevant for judging and assessing the structural qualities of the existing building in a way that all subsequent design steps and the referenced bespoke design concept can rely upon.

6. Considerations on Structural Safety

6.1. Due to the fact that existing structures can´t easily be dealt with by simply applying the current set of technical rules and regulations for new buildings, additional considerations for guaranteeing their structural integrity are necessary.

6.2. These considerations must be split between structural safety issues – ultimate limit states

– that have a direct impact on the safety level expected by society, and serviceability issues – serviceability limit state – that affect the future use only and are therefore of secondary importance.

6.3. Addressing the structural safety aspects firstly, the probability of failure accepted by society for any building has to be met by refurbished/amended/adapted buildings as well new (see for example EN 1990:2021). Bearing in mind that the current set of technical rules and regulations apply to new buildings and new building works (which can include major refurbishments and repurposing of buildings), applying these retrospectively for the maintenance of existing structures may/can lead to severe misjudgments. Hence the following recommendations are given:

- By adopting strategies to detect structural sensitivities, in essence the evaluation of the generalized Green-Functions of the structure, both the detailed on-site investigation and the in- depth analysis can focus on the structure´s weak spots.
- By taking the actual on-site, and via lab-tests, derived mechanical and statistical properties of single components, assemblies or the structure as a whole (including the effects of actions into account), the actual probability of failure can be calculated and translated to generally accepted values (i.e. for most cases 10-6 for a return period of 50 years).
- If the statistical data at hand is not sufficient, reference to probabilistic data bases for materials, cross-section-parameters and actions, like the probabilistic model code, issued by the Joint Committee on Structural Safety – JCSS – can be made.

6.4. Secondly, addressing the serviceability limit state, the requirements taken from the actual valid set of technical rules and regulations are to be understood purely as recommendations within

the context of existing structures. These recommendations may define the basis for bespoke specifications, but if these were not met, the structural integrity isn´t harmed. Hence, it´s up to the owner/client and the designer to define reasonable thresholds.

6.5. In the case of extending an existing building with new building sections, special considerations to align the explained, bespoke structural safety concept with the structural safety concept for new construction, as defined in the current set of technical rules and regulations for new buildings.

6.6. All deliberations focusing on structural safety have to be guided by the principle that as society doesn´t distinguish between a new building or old, including those that have been repurposed, refurbished or extended, the operative probability of failure has to be the same. So it´s up to the designer to choose by which means this aim is met.

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Footnote 29: Unpublished Guidance on determining and assessing the building’s fire safety Disclaimer

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1. General Principles

1.1. By determining and assessing a building´s fire safety, a reliable and robust basis can be established for all further considerations, whether these aim at preserving existing buildings only or a fundamental refurbishment and possible extension of those.

1.2. The Right of Continuance/Grandfathering only extends as far as the future use of the building where it does not deter from the past (i.e., fire load regimes, occupant characteristics exposition to climatic actions, chemical and/or environmental issues).

1.3. Applying up-to-date technical rules and regulations to existing structures will often lead to contradictions and discrepancies that are not inevitable or an indicator for inadequate fire safety.

1.4. Determining the actual fire safety of existing buildings, provides the basis for a bespoke design and verification concept, using the general principles for fire safety engineering and establishing the probability of failure that is accepted by society.

1.5. It is essential to understand that the establishment of the fire safety strategy of an existing building has to occur having the profile and the purpose of its intended future use in mind.

2. Existing Documents

2.1. The first and primary source for assessing the fire safety of an existing structure are Inventory Documents, including:

- As-Buit-Drawings
- Fire Safety Strategy
- Fire Risk Assessment
- Permits
- Maintenance reports
- Expertise statements for special purposes (such as structural fire engineering, fire incident reports).

2.2. Of comparable importance is information about fire safety alterations/modifications, such as change of use or the introduction of new hazards/risks.

2.3. Besides the building-specific documents, another crucial source of information for establishing the fire safety of the building at hand are the technical rules and regulations valid at the time of design and erection of the structure.

2.4. It is also worthwhile to consult secondary sources to understand and integrate the basics of the design philosophy and the execution methods and quality of the era in which the building was constructed.

3. In-Situ Investigations

3.1. Double-checking the information gained throughout the study of the existing documents or, if the existing documents aren´t sufficient, in-situ investigations are a must.

3.2. Depending on the depth of the information gained by analysing the inventory documents, the in-situ investigations may differ in character from random sample spot checks to full-blown inventory covering the geometrical as well as the material side.

3.3. Special attention has to be paid to construction and materials, passive and active systems, the amendments/modifications introduced during the buildings life-span and the materials and systems used against the information derived from the inventory documents.

3.4. Non-destructive and destructive testing methods, both on-site as well as in the laboratory, are to be used in order to gain this information.

4. History of the Building

4.1. Assessors should conduct a study, where possible, of all original documents relevant to the building's construction and performance in fire. On-site verification should be carried out to establish the veracity of the information, the extent of which should be determined by the quality and extent of the documentation available.

4.2. Where details on the systems and the methods of construction used cannot be established from documentation and initial on-site verification work, the extent of site survey and inspection should be increased accordingly.

5. Updating the Fire Safety Strategy

5.1. Assessors should establish the fire safety strategy for the building. The strategy may exist however in most instance a strategy will need to establish to address the various objective.

5.2. A building's fire safety strategy needs to be bespoked to include all aspects of its fire safety features. These include construction, passive and active fire systems, means of escape, lighting and signage, compartmentation, as well as ensuring management arrangements for evacuation are fit for purpose for the end user of the premises.

6. Considerations On Fire Safety

6.1. Ensuring fire safety in existing structures may require additional considerations beyond current technical rules for new buildings. This may involve assessing the building's current condition, historical significance and any modifications that have been made over time.

6.2. The primary task is to develop a brief by collaboratively recording objectives and targets agreed upon by stakeholders. Stakeholders may include building owners, tenants, local fire authorities and architects. This collaboration ensures all perspectives are considered and integrated into the fire safety strategy. Evaluation is either on a comparative or absolute basis.

6.3. A comparative approach checks if the existing building meets or exceeds current rules, often called an "equivalence" approach.

6.4. An absolute evaluation matches trial design analysis results against current rules or benchmarks using agreed criteria. This process includes rigorous testing scenarios, simulations and performance assessments to ensure compliance with established fire safety benchmarks.

The absolute evaluation may involve a risk assessment.

6.5. For complex buildings, third-party verification against objectives is recommended. Engaging third-party experts provides an unbiased assessment and validation of the fire safety measures. These experts can often offer insights and recommendations that might be overlooked by internal teams, ensuring comprehensive safety compliance.

6.6. All deliberations focusing on fire safety must be guided by the principle that as society may not distinguish between a new building or old, including those that have been repurposed, refurbished or extended, the operative probability of failure has to be the same. It is up to the designer to choose by which means this aim is met.

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