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Introduction

What is building pathology?

The term *pathology* is defined as the systematic study of diseases with the aim of understanding their causes, symptoms and treatment. In a medical context, the person becomes the subject of detailed examination and investigation, with consideration given to age, health and lifestyle. A similar approach is relevant in the study of buildings, and it is this methodical and often forensic practice that has come to be termed *building pathology*.

Building pathology, both as a term and as an overall concept, has become more widely used to define the holistic approach to understanding buildings. Such an approach requires a detailed knowledge of how buildings are designed, constructed, used and changed, and the various mechanisms by which their material and environmental conditions can be affected. It is, by necessity, an interdisciplinary approach and requires a wider recognition of the ways in which buildings and people react and respond to each other.

The definition of building pathology given by the Association of European Experts in Building and Construction (AEEBC) draws attention to three separate, though interrelated, areas of concern:

- identification, investigation and diagnosis of defects in existing buildings
- prognosis of defects diagnosed and recommendations for the most appropriate course of action having regard to the building, its future and resources available
- design, specification, implementation and supervision of appropriate programmes of remedial works and monitoring and evaluation of remedial works in terms of their functional, technical and economic performance in use

Other definitions include:

- study of failures in the interrelationship of building structures and materials with their environments, occupants and contents (Hutton + Rostron)
- study of failures over time in building materials and components (Groák)
- systematic treatment of building defects, their causes, their consequences and their remedies (CIB W86 Building Pathology Commission)

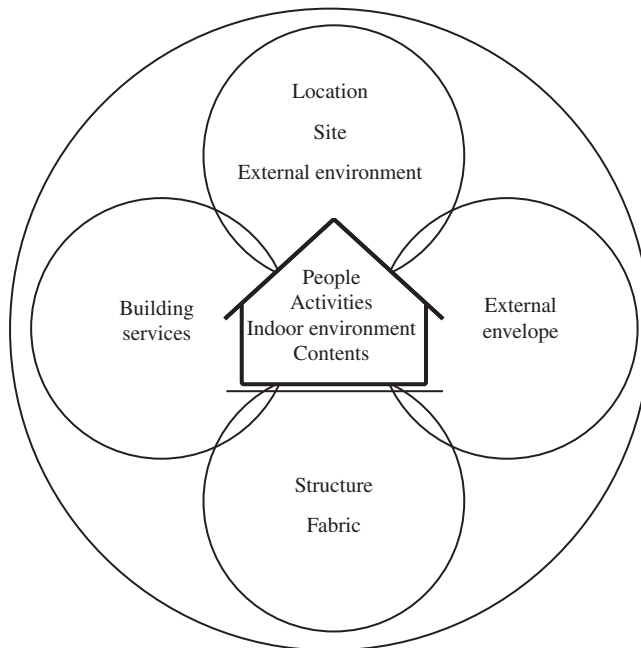
- scientific study of abnormalities in the structure and functioning of the building envelope and its parts; it seeks to study the interrelationships of building materials, construction, services and spatial arrangement with their environments, occupants and contents (Singh)
- forensic approach to inspecting, investigating and problem-solving in buildings and finding solutions (CIOB Academy)
- holistic approach to studying and understanding buildings and, in particular, building defects and associated remedial action. In a medical context, pathology is the study of diseases in order to determine their causes and prescribe treatment. Similarly, building pathology involves the methodical study of buildings, their components and their environment to address failures (Designing Buildings)
- process by which the history and condition of a building, and its suitability for improvement, are analysed systematically as part of its assessment for retrofit (PAS 2035). The whole-dwelling approach described in this publicly available specification considers a building to be a system of elements, interfaces and occupants that interact, rather than a set of elements that are independent of each other or of the practices or lifestyles of the occupants

The International Council for Research and Innovation in Building and Construction (CIB; formerly International Council for Building) was established in 1953 to stimulate and facilitate international cooperation and information exchange. It has since developed into a worldwide network whose members are active in over 30 working commissions covering all fields in building and construction-related research and innovation. The objectives of the Building Pathology Commission (W86) are to conduct basic and applied research; promote meetings and webinars about the application of building pathology; disseminate information to those involved in the design, construction and management of buildings; participate in creating international and national standardisation or technical notes and strengthen connections with relevant CIB commissions and other organisations.

Although each definition places a slightly different emphasis on aspects of the discipline – in particular the link to retrofit given in PAS 2035 – it is clear that building pathology, in its widest sense, is concerned principally with performance, defects and associated remedial action. The lessons that can be learnt from such a structured approach can also be brought into play when altering existing buildings or in the design of new buildings. The purpose of this book is therefore to expand the range of investigation normally undertaken in the surveying of buildings and to draw together various categories of information that are required to make informed decisions about how buildings might be adapted, repaired and best utilised now and in the future.

Why take a holistic approach to understanding buildings?

Buildings do not exist in isolation, but instead represent various levels of action and interaction between people and their surroundings – on the one hand, they can be expressions of creative impulse and, on the other, simple statements of functional need. Put another way, they are complex systems of materials and environments evolving over time. In whichever form the building exists, it is a physical response to people, place and environment. Shifts in the balance between these three factors are responsible for many of the decisions around which buildings are built, occupied, adapted and ultimately destroyed.



Buildings in context, reflecting intersecting systems and highlighting the importance of adopting an inclusive holistic approach to understanding performance and failure.

In order to understand a building, it must first be considered in context, from when it was designed and built, through changes over time, to its present use today. This progression takes into account various actions, some significant and others more mundane, but all giving information that may have relevance to understanding the building in the context of the present. Such an approach has much in common with archaeology, combining aspects of discovery, scientific analysis and creative imagination, but with the wider objective of informing decisions that will affect the present and the future.



Archaeological investigation that helps understand the history and development of buildings.

Taking a wider view of a building thus requires a level of understanding that, apart from simple examples, will often require the knowledge and experience of various disciplines. Those who might commonly be called upon to offer advice or an opinion as part of an interdisciplinary team may include:

- administrators and asset, building or facilities managers
- archaeologists
- architects and designers
- art and architectural historians
- building control approver or building inspector
- building services engineers
- building surveyors
- conservation officers
- disaster/emergency managers
- ecologists
- environmental and material scientists
- fire safety engineers
- garden and landscape consultants
- general practice and investment surveyors
- insurers and loss adjusters
- interior designers
- quantity surveyors
- town and urban planners
- structural and civil engineers

Additional advice, information or comment may also be received from:

- amenity societies and community groups
- governmental departments and organisations
- non-governmental organisations
- owners and occupiers
- public utilities (e.g. communications, electricity, gas, water)
- service staff (e.g. caretakers, cleaners, ground staff, security)
- local authorities (e.g. building control, environmental health, planning, transportation)

More specialised information may additionally be required from other groups or individuals when dealing with particular building types or situations. Those who might contribute to an understanding of historic buildings may, for instance, include conservators, curators and craftworkers. Other sources of information may have to be sought and examined for each specific need.

The needs required to form an understanding of a building must consider the building in context with its location and use. Consideration of one without the others is a common fault that may ultimately lead to dissatisfaction, unnecessary expense or unjustifiable change.

Whilst it has become the norm to specialise, there is merit in retaining a wider set of interests and learning through a variety of means. Static learning solely from books can take one so far, but experience gained through dynamic learning – by watching, discussing and attempting a particular task – will provide a better grounding. Specialisation can also

stifle the skills of problem-solving and cause one to miss synergies (combined actions or operations) that might exist between one set of conditions and another. Far better to have several areas of interest or expertise and recognise that a task, such as understanding a building defect, can be better done by thinking in terms of systems rather than a more common reductionist view of seeing only a set of separate parts. This is at the core of what building pathology is about.

Needs of the building

Buildings, together with their contents, present a complex assembly of materials and parts. Each material, whether it forms an identifiable element or component of the construction or part of the internal fabric, has its own characteristics and requirements. Traditional buildings, which are essentially a collection of natural materials, rely on soft mortars, sacrificial renders, moisture–vapour permeable plaster and finishes and natural ventilation to retain their integrity and cohesion. This is in contrast to more modern buildings that make use of cement and concrete, plastics, composites and other artificial or human-made materials to fulfil the requirements of client, designer and statutory authority.

The needs of the building, of whatever age or construction, must be understood, respected and responded to if it is to function to an acceptable standard. It is these needs, and the question of what is ‘acceptable’, that will be considered in later parts of this book.



The design, construction and use of contemporary buildings differ in many ways from those of previous generations.

Needs of the building user

The use and function of buildings change over time, and with each change comes a different, and often conflicting, set of requirements. These user requirements will typically leave evidence in the form of physical changes to the structure, fabric and services of the building; personal recollections and remembrances and associated documentation. Each of these levels of evidence will provide potentially useful information to be collected and considered when attempting to understand a building or collection of buildings. The question to ask is, 'How have we arrived at the point we are now?'

The relevance of building pathology

The relevance of building pathology to practitioners and students of built environment disciplines, and others who are responsible for managing buildings and their sites, lies principally in the need for more accurate and appropriate information on which to base decisions. This need may arise for a variety of reasons:

- determine financial security against an intended loan or mortgage, or change of ownership
- provide confidence on acquisition for occupation or investment by way of a report commissioned by a purchaser or vendor wishing to confirm or disclose material facts (technical due diligence survey)
- determine stability and risk of failure following natural or man-made disasters
- establish liability for disrepair (dilapidations)
- diagnose defects when symptoms appear to occupiers
- determine the effectiveness of past repairs or maintenance
- assess levels of disrepair in advance of legal proceedings
- acquire information about a building including design, construction, occupation, refurbishment and ongoing management (e.g. knowledge acquisition survey, golden thread)
- understand key aspects of buildings and facilities to inform strategies and manage risk (six-facet survey)
- ensure compliance with legal requirements
- understand and document factors affecting condition
- provide a basis for planned work (repair, maintenance, retrofit)
- provide a basis for physical change (adaptation, change of use)
- inform post-occupancy evaluations
- provide opinion in court (Part 35 compliant expert witness report)

Whatever the reason, this need for accurate and appropriate information, acquired at a cost that is acceptable to the client, will require a change in the ways in which buildings are perceived and dealt with. The acceptance and practice of building pathology – providing a holistic approach to understanding buildings – will add an extra dimension to what many professional advisers already offer. As such, its relevance needs to be acknowledged and understood, and its principles more fully adopted.

The principles and practice of building pathology

The principles upon which building pathology is based rely on a detailed knowledge of how a building is designed, constructed, used and changed and the various mechanisms by which its structural, material and environmental conditions can be affected. It is more than just a detailed building survey, for it acknowledges the relative importance of people, place and environment. Such a comprehensive approach to understanding buildings offers potential for developing a deeper understanding and providing more useful information.

It is often said that every art benefits from a little science and every science benefits from a little art. Building pathology is very much an art and a science. Whilst the diagnosis of building failures may require detailed investigation, which could include testing, analysis and monitoring, it also requires imagination to ask questions, reflect on events and causes and conceive appropriate courses of action.

The following chapters are laid out to provide a logical progression, with consideration of buildings, building performance, causes and effects of problems, survey and assessment, remediation in practice and principles of building management and aftercare.

What is building pathology?

Building pathology
offers a holistic approach to
understanding the built environment
by recognising relationships between people,
buildings, environments, uses and contents. This
requires critical thinking. It encourages collaboration
between different professional groups and embraces a wider set of interests.

This includes legislation (fire,
safety, planning, environment),
history (art, architecture,
social, political), health and
well-being, building services,
sustainability, ecology,
technology, construction,
engineering, archaeology and
cultural studies, design
(architecture, interiors,
furnishings) and sciences
(biology, chemistry,
physics, geology,
environment,
materials).

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