Evidence-Based Design

For MSc. Students (Architecture)
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Building Pathology

Prof. Dr. Faris Ali Mustafa
Department of Architecture, College of Engineering, SUE

Buildings

- ✓ Buildings may be seen as a collection of different layers that interact and respond to one another, but ultimately have to fit together.
- ✓ They are very expensive and impactful objects, with complex (social and cultural/environmental/economic) assets.
- ✓ Their value - in our country at least - was not always linked to their quality (ability to meet needs) or their operating costs.

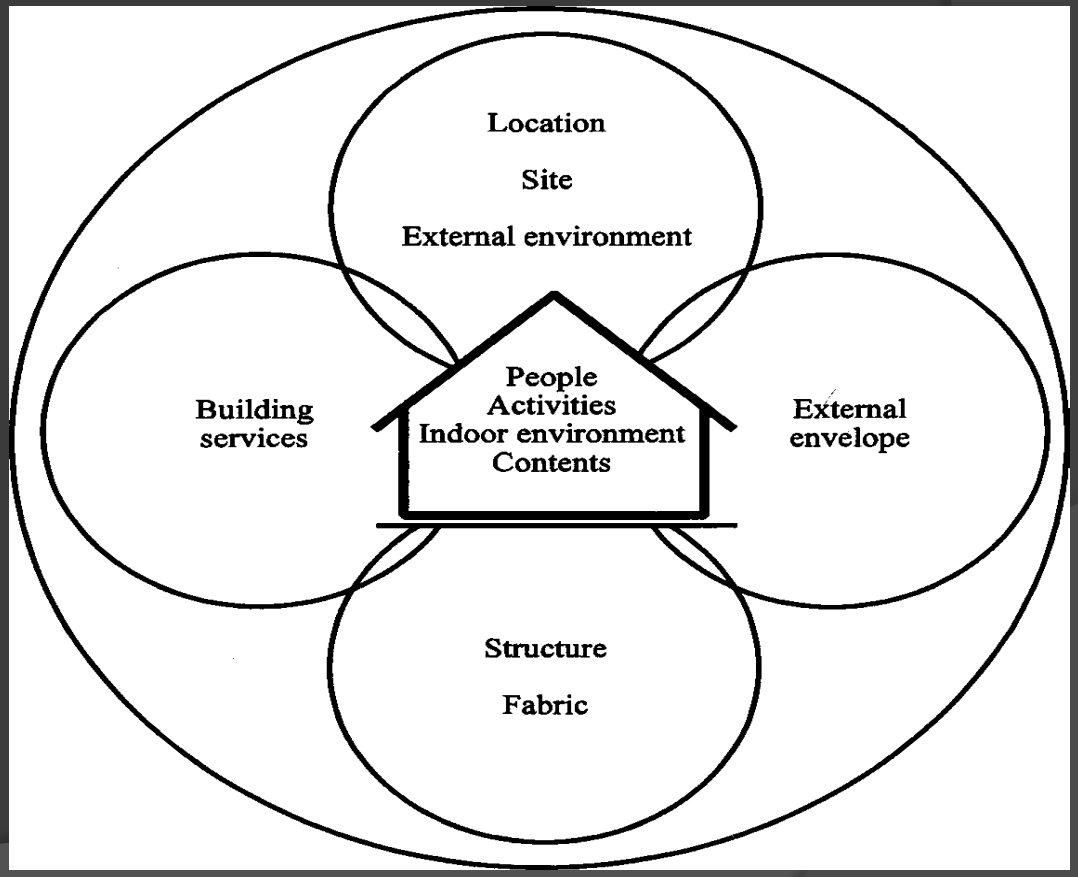

Fig 1. Buildings in context.

Building in Architecture

In architecture as in all other operative arts, the end must direct the operation. The end is to build well.

Well building has three conditions:

1. Commodity: user satisfaction,
2. Firmness: structurally sound, and
3. Delight: aesthetically, pleasing.

What is Building Pathology? Diagnosing Building Problems

- Building Pathology is the study of building defects, building deterioration and building performance to develop suitable remedial and management solutions.

- The discipline looks at the interrelationships between the physical building, its use, occupation and environment to gain valuable insights into why buildings fail.

What is Building Pathology?

- The term pathology has been applied to building problems for only a few decades, the reasoning behind this is quite clear; like medically treated bodies, building moves, breathes, gets sick, ages, and dies. And while nothing lasts forever, buildings can stay in great condition until late in their life.

What is Building Pathology?

- Mike Parrett, who is one of the UK's leading building pathologists and co-author of the RICS (Royal Institution of Chartered Surveyors) best seller, "Diagnosing Damp", states that "**building failure is a problem that needs to be looked at holistically**".

- Issues, such as damp/moisture, is poorly understood and can easily be misdiagnosed. He also states that no expert in the building design, construction, surveying or maintenance of buildings can bear the failure in applying the building pathology method.

Building pathology

Building pathology is a holistic approach to studying and understanding buildings and, in particular, building defects and associated remedial actions.

In a medical context, pathology is the study of diseases to determine their causes and prescribe treatment.

Similarly, **building pathology** involves a systematic study of buildings, their components, and environment, to address failures.

Building pathology

Building defects are aspects of a building that were not completed in accordance with the contract or that failed.

Defects can be 'patent' or 'latent'.

- Patent defects are those which can be discovered by reasonable inspection.
- Latent defects are those which cannot be discovered by reasonable inspection, for example problems with foundations which may not be apparent.

Building defects

Defects may be caused by a wide range of problems, such as:

- Design deficiencies.
- Material deficiencies.
- Specification problems.
- Workmanship deficiencies.
- Deterioration.
- Maintenance and repair deficiencies.
- Improper use.
- Environmental and other external factors.

Building defects

Defects may be:

- Fundamental: For example, requiring demolition, making the building unsafe.
- Functional: Affecting the clients beneficial occupancy of the building.
- Cosmetic: not in compliance with the contract, but does not affect the clients beneficial occupancy of the building.

Building defects

When defects become evident, remedial work may be necessary to correct them. However, this is not always clear:

- ✓ It is not always clear what constitutes a defect.
- ✓ It is not always clear what has caused a defect. It may be a combination of design and workmanship deficiencies, or an apparent defect in finishes may actually be caused by a structural problem.
- ✓ It is not always clear where the fault lies, or it may lie with more than one party.
- ✓ The remedial works necessary to correct a defect may be very extensive, complex, costly, time consuming or it is not compatible with the nature of the defect itself.

Building Pathology Approach

Building pathology takes an interdisciplinary, holistic approach which recognizes that buildings do not exist in isolation, but necessarily interact with occupants and their surroundings. Failure to adopt such an approach, can lead to misdiagnosis.

Very broadly, **building pathology** consists of three main activities:

1. Identifying, investigating and determining the nature of building defects.

2. Recommending the most appropriate course of action.

3. Design, supervision and monitoring of remedial works.

Building Pathology Investigations

- Investigations may begin with a detailed survey and a desk study to collect historical and background information.

- The building must be viewed in its context, from the time it was designed and built, through the changes that have occurred in its current function.

- In this way, building pathology has similarities with the practice of archaeology. Each material or component that makes up a building has its own characteristics and requirements, which can lead to different kinds of failure.

- These must be investigated and carefully considered in order to diagnose problems and develop an appropriate remedial strategy.

Building Pathology Uses and Applications

Building pathology may be used to:

- Provide confidence to the potential client or renter.
- Determine responsibility for deterioration.
- Determine stability and risk of failure.

- Diagnose defects when symptoms appear.
- Identify and understand the reasons/causes of the current situation.
- Ensure compliance with legal requirements.

- Provide a strategy for repairs or maintenance.
- Provide expert witness evidence.
- Provide damage assessments after an accident.

- Assess performance.
- Provide management solutions.
- Value remedial works.

Building Pathology Assessment

Typical issues that may require assessment may include:

- Penetrating and interstitial damp.
- Cracking and building movement.
- Rot, corrosion, mold growth and infestation.
- Harmful materials.
- Thermal performance, air tightness and cold bridges.
- Interaction with trees.
- Drainage problems.
- Occupant health and wellbeing.
- Noise problems.
- Crowding/congestion and space/spaciousness
- Security
- Lighting

Requirements of buildings

In order to be successful, the building design and construction must take into account a variety of issues. In other words, the building must meet certain criteria after construction. These can be considered as:

1. Functional requirements
2. Performance requirements
3. Statutory/legal requirements
4. User requirements

1. Functional Requirements

- Every building, regardless of its original, intermediate or final use, is expected to achieve some basic functional requirements. These requirements are mainly concerned with protection from the external environment, human comfort, and organization of activities and spaces.
- Other functional needs might include creating a particular sense of identity or place, and controlling competing or conflicting internal uses.
- Unless the function of a building is known, it cannot be judged as good or bad.

2. Performance requirements

For a building to be successful, it must satisfy the basic functional requirements noted above.

How it meets these requirements, whether as a building or as a set of interconnected parts, can be determined by how it performs in relation to several specific performance measures or criteria.

The performance requirements of a building and its various elements can be considered under the following headings, as illustrated in Fig. 2:

2. Performance requirements

- ✓ Access and egress
- ✓ Appearance
- ✓ Durability
- ✓ Dimensional suitability
- ✓ Strength and stability
- ✓ Weather exclusion (unwanted conditions)
- ✓ Sound control (visual and acoustic privacy)
- ✓ Thermal comfort
- ✓ Fire protection
- ✓ Lighting and ventilation
- ✓ Sanitation
- ✓ Security
- ✓ Cost

Many of these performance requirements form the basis of statutory and non-statutory demands that must be met, in relation to both new buildings and the continued use of those that already exist.

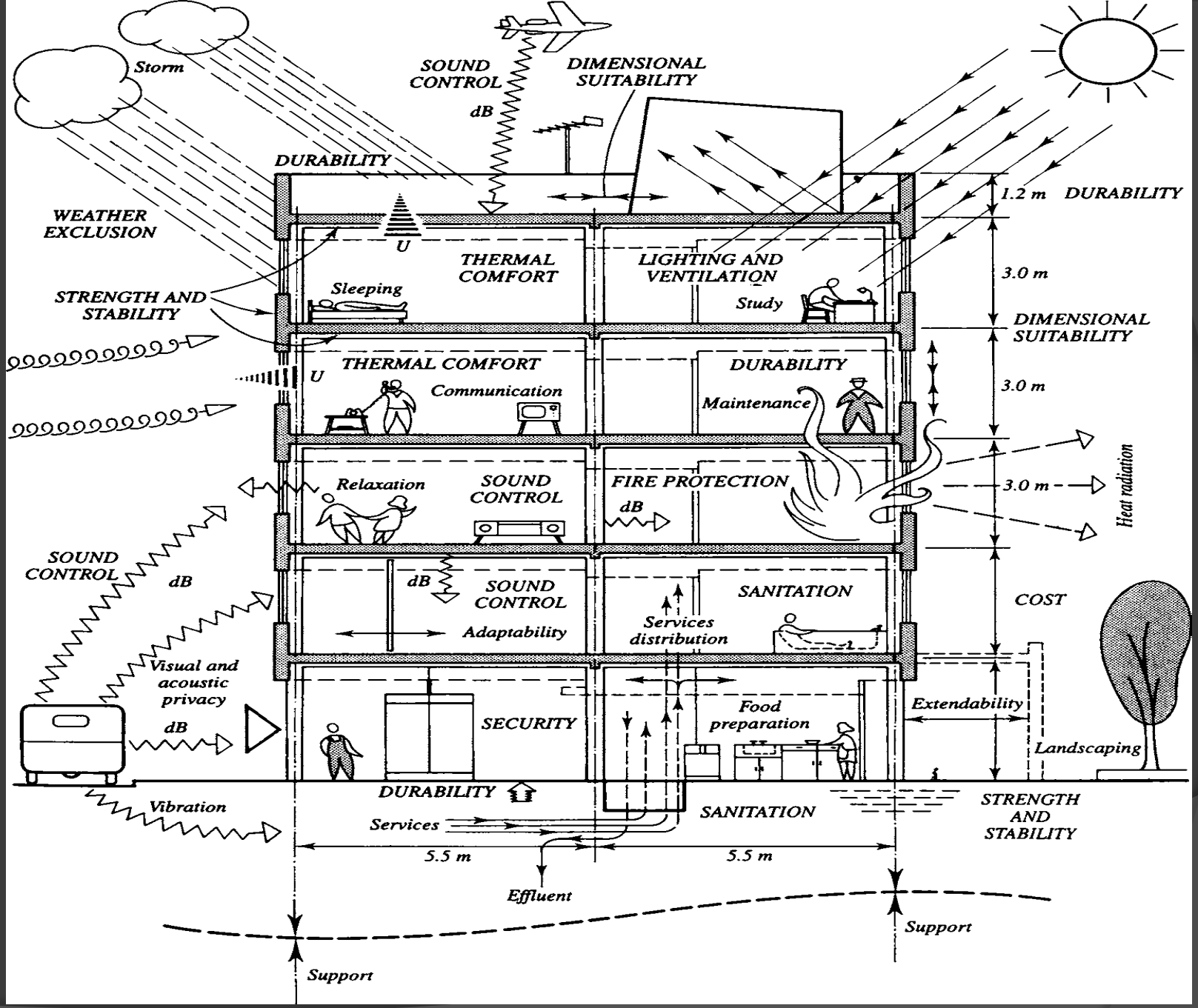

Fig 2. Performance requirements for buildings.

3. Statutory requirements

There are various statutory and non-statutory requirements that make demands on those who design, build, manage, repair, maintain, occupy or demolish buildings. In practical terms, many of these demands relate to the health, safety and well-being of these people. Some of the main sources of statutory and non-statutory requirements (many with subsequent amendments and revisions) are:

- London Building Acts 1930–39
- Public Health Acts 1936, 1961
- Factories Act 1961
- Offices, Shops and Railway Premises Act 1963
- Fire Precautions Act 1971
- Health and Safety at Work, etc Act 1974
- Ancient Monuments and Archaeological Areas Act 1979
- Building Act 1984 Housing Act 1985
- Town and Country Planning Act 1990
- Planning (Listed Buildings and Conservation Areas) Act 1990
- Environmental Protection Act 1990
- Planning Policy Guidance 16: Archaeology and Planning 1990
- Workplace (Health, Safety and Welfare) Regulations 1992
- Control of Substances Hazardous to Health Regulations 1994

4. User Requirements

The building user can expect to live or work in a space that meets basic human requirements and, in addition, certain needs that are specific to the activities being performed.

The methods of achieving this, and whether one of them is incompatible with the other, are a measure of the building suitability for the activity or activities in question.

Suitability for purpose is therefore an important measure of how a building matches the requirements of its user.

4. User Requirements

User requirement studies attempt to identify purpose in terms of activities (the things people do) and human needs (physical, psychological, physiological and social), and for a building to be fit for its purpose it must allow its occupants to carry out their activities economically and suitably, and have a satisfactory environment to suit the user. Such a study will typically consider:

- Classification of user (e.g. task orientation)
- Analysis of activities (e.g. social interaction)
- Requirements of space (e.g. circulation in and around building)
- Environmental conditions (e.g. sensory stimulation)
- Structural effects (e.g. compatibility)
- Cost (e.g. improvements)

4. User Requirements

- A study of the user's specific needs will help determine what the building must provide to meet user activities and human necessities.

4. User Requirements

- User requirements within a particular building may sometimes conflict with the structural, physical and/or environmental needs of the building or its contents.
- This may be of particular concern when dealing with historic buildings, where careless alterations or adaptations can cause irreparable damage both to the structure and fabric of the building, and to the aesthetic qualities of its spaces.
- When there is such a conflict, it is important that the needs of both the building and the user(s) are clearly identified, the importance of the building being evaluated, and the implications of bias or cooperation are fully understood.

Research and studies on building pathology may cover:

Conservation and durability of historic buildings, quality of life and durability of the building envelope, materials and their suitability and modeling, among other relevant topics.

- Coverage includes recent developments and applications of rehabilitation of monumental heritage and historic buildings and architecture, appraisal and refurbishment of buildings.

Research and studies on building pathology may cover:

- ✓ Other topics include hydrothermal behavior of buildings; structural pathologies of stone, wood, mortar and concrete; diagnostic methodology, traditional and innovative techniques, non-destructive methodologies; **rehabilitation of the constructed heritage; energy efficiency; building materials: ecology, nanotechnology and recent trends; applications and limitations of novel building technologies; performance simulation and case studies.**

- ✓ Developments and applications of rehabilitation of monumental heritage and historic buildings.

Research and studies on building pathology may cover:

- ✓ Concerning innovative investigations on topics related to: the technical and pathological issues associated with maintaining and conserving buildings; and the refurbishment and adaptation of existing buildings in response to environmental, technological and societal developments.

- ✓ **Particular emphasis is placed on the emerging environmental challenges and application of digital technologies (including BIM, augmented and virtual reality) with sustaining and conserving buildings.**

Research and studies on building pathology may cover:

- ✓ Include all building types and architectural forms, including historical buildings, the associated infrastructure and technologies, together with the methodologies applied in the context of surveying, adapting, converting, conserving, maintaining and managing these.
- ✓ The scope and coverage of this approach (Building Pathology), by design, is appropriately diverse and multi-disciplinary, reflecting the emerging technological, environmental and societal challenges of sustaining resilient buildings in all regions of the world.

Research and studies on building pathology may cover:

- Behavioral and human responses
- Building defects and diagnosis
- Building adaptation and retrofitting
- Building conservation and restoration
- Building Information Modeling (BIM)
- Building and planning regulations and legislation
- Building technology
- Conflict avoidance, management and conflict resolution
- Digital information and communication technologies
- Education and training
- Environmental performance
- Energy management
- Health, safety and welfare issues
- Healthy enclosures
- Innovations and innovative technologies
- Law and practice of dilapidation
- Maintenance and refurbishment
- Materials testing
- Policy formulation and development
- Project management
- Resilience
- Structural considerations
- Surveying methodologies and techniques
- Sustainability and climate change
- Valuation and financial investment

International Journal of Building Pathology and Adaptation

https://www.emerald.com/insight/publication/issn/2398-4708

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