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Historic Buildings and Sustainability: The Knowledge Buildings Hold and Passive Design Solutions

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The new European directive on energy efficiency will have to be transposed by many countries soon in order to meet decarbonization targets. Its implementation across a continent characterized by buildings of varying age and state of conservation will be most effective if this transposition takes into account the diverse characteristics and values that distinguish these structures. Newly constructed buildings can incorporate effective solutions for reaching these goals. More generally, even ordinary buildings on the outskirts of expanding historic centers are well suited to integrating energy-efficient solutions. For historic buildings, the situation is markedly different. A distinction must be made between structures built before 1945 and those formally classified as cultural heritage, which represent only a small portion of Europe's building stock. For the latter, unsuitable measures derived from energy efficiency practices developed in other contexts must be avoided. At the same time, these buildings should not be automatically exempted from energy efficiency targets; instead, suitable measures should be identified, including innovative approaches. Of greatest concern, owing to the considerable discretion afforded to individual countries, are the older buildings not formally recognized as cultural heritage. These structures, which account for 25 to 30 percent of the total building stock, form part of Europe's collective identity and are at risk of significant alteration as a consequence of the climate neutrality targets introduced by the European Union. This raises key questions about safeguarding the values of historic buildings, recognizing the role of structures built before the advent of climate and comfort control systems, and identifying the tools already available to support this transition. This contribution does not aim to propose specific construction practices but rather to clarify the regulatory framework and objectives of energy efficiency in relation to historic buildings, focusing on certain particularly significant aspects. Ongoing projects with Italian stakeholders are closely related to these reflections, and their results may be presented in due course.

Introduction

Having set the goal of zero land consumption and net-zero greenhouse gas emissions by 2050, the European Green Deal policies for the construction sector play a pivotal role in guiding the measures individual European countries must adopt to achieve a green transition in the built environment. These objectives can be considered complementary in that reducing, if not eliminating, land consumption necessarily entails a progressive increase in the reuse and conservation of the existing building stock. European Commission President Ursula von der Leyen emphasized

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this in her inaugural address at the start of her first mandate, calling for a "Renovation Wave" across Europe, aimed not only at reducing polluting emissions but also at improving energy efficiency.

Within the broader European context, buildings constructed before 1945 account for approximately 25 to 30 percent of the total stock, while those subject to specific protection measures and formally recognized as cultural heritage range between 1 and 5 percent, depending on the country (Litti, 2022). Italy is no exception: here too, buildings constructed before 1945 account for around 25 percent of the total, while those of historical and artistic interest—therefore subject to the Cultural Heritage and Landscape Code—amount to approximately 250,000.

Apart from the buildings already subject to protection, for which the Superintendency monitors transformations on behalf of the Ministry of Culture, the remaining stock—particularly historic buildings—requires clearly defined value criteria to guide classification. Establishing such criteria is a necessary step in devising strategies for the reuse of built heritage (Trovò, 2024) and in avoiding the homogenization of distinct architectural characteristics. Effective reuse strategies must be tailored to the type of building, its state of conservation, and its defining features, which include criteria that may vary significantly (Spoormans and Pereira Roders 2010). Only in this way is it possible to define appropriate actions across a spectrum ranging from radical conservation to demolition and reconstruction.

Restoration, understood as a regulated activity governed by requirements and objectives for conserving architectural heritage, is inherently a sustainable practice. It presupposes preservation within a framework in which demolitions are only a minor component of the overall intervention. Restoration is traditionally associated with works on cultural heritage assets or, by extension, on buildings of cultural significance, as defined in the Cultural Heritage and Landscape Code. Yet even when other forms of rehabilitation do not fully adhere to the rigor of restoration theory and practice, they can still be traced to the same sustainability paradigm, minimizing reliance on new resources and materials as well as the energy required for producing, transporting, and utilizing them.

The other key objective of the European Green Deal—decarbonization and energy efficiency—has led to the adoption of several directives. The most recent is the Energy Performance of Buildings Directive (EPBD 2024/1275), which Member States must implement by 29 May 2026. Its goals are to improve the energy performance of buildings and reduce greenhouse gas emissions in the construction sector, which is responsible for about 40 percent of final energy consumption in the European Union, where 75 percent of the building stock remains energy inefficient. The directive aims at the progressive reduction of emissions and energy consumption by 2050, requiring Member States to draw up national restoration plans with the goal of making buildings zero-emission. It also requires residential buildings to achieve a reduction in the average use of primary energy by at least 16 percent by 2030 and between 20 and 22 percent by 2035, compared to 2020 levels. In addition, at least 16 percent of nonresidential buildings must meet minimum energy performance requirements by 2030 and 26 percent by 2033. From 2028 onward, all new public buildings must be zero-emission, with privately owned buildings required to follow from 2030 onward. Regarding the policies to be adopted for renovating existing buildings, the directive also emphasizes the strategic role of financial support mechanisms for energy retrofitting, with particular emphasis on the least efficient buildings.

For the historic building stock, the directive allows exemptions from the decarbonization and energy efficiency requirements for specific categories, including protected and listed buildings, historic properties, temporary structures, churches and other places of worship, detached dwellings with a floor area of less than 50 square meters, and secondary residences used for fewer than four months per year. While these exemptions are clearly useful when a building's documentary, historical, or artistic recognition makes compliance with cultural and ecological requirements impracticable, they can also inadvertently justify neglecting opportunities to pursue solutions that can reconcile the previously mentioned cultural and ecological goals. This makes it necessary to promote processes—whether or not supported by green transition incentives—that reward performance improvements, moving beyond compliance as the sole pathway to energy efficiency, particularly in relation to historic architecture.

In-depth study of historic buildings can ascertain the role of their existing features and identify the inherent mechanisms they offer, facilitating the development of best practices for improving energy efficiency while preserving architectural character. The first step in this process is to investigate the existing passive design systems, historically intended to enhance environmental comfort through architectural solutions that predated the widespread use of mechanical systems. The next is to carry out a detailed geometric survey, identifying the materials with good insulating properties and the service systems whose spaces and conduits can be reused rather than creating new ones that might interfere with conservation goals.

Passive Design in the History of Building Construction: The Case of the Veneto

Any study of passive performance in historic buildings must begin with foundational definitions. The concept of *passive building* is inextricably linked to the energy performance of its envelope, which determines the building's capacity to meet energy needs without mechanical devices. Whereas contemporary construction practices tend to rely on mechanical systems to respond to climatic variations, builders in earlier times who lacked technological tools depended on contextual *best practices* to mitigate environmental fluctuations. Location, orientation, roof slope, shading systems, external surface color, and the size and placement of openings all played a fundamental role.

Thorough analysis of selected case studies exemplifying salient characteristics was made possible through the Italian National Recovery and Resilience Plan (Piano Nazionale di Ripresa e Resilienza, PNRR). In particular, the work was supported by the iNEST funds allocated to North-Eastern Italy and, specifically, to the Veneto region. This area is geographically rich in energy sources, rainwater, and agriculture and characterized by a strong entrepreneurial culture that fosters energy conversion processes in the built environment. The research behind this contribution focused on historic buildings within this geographical context, including those well documented in the following project.

The ATTES guidelines (A.T.T.E.S., 2010) were among the first documents to address research on the energy resilience of buildings in a systematic way. Focusing on sustainable development, historic construction, and bioclimatic architecture, they underscored the scale of the challenge taken on by the European Union, which had identified environmental issues as one of the cornerstones of its community policy in the Single European Act of 1986.

One of the key principles of these guidelines is that projects involving historic buildings must consider the building's energy performance, understood as a resource in pursuing efficiency goals. This perspective makes it possible to leverage passive behavior in relation to solar orientation, wind, natural light, and shading systems—all of which are considered elements of energy quality.

From this standpoint, interventions on the built environment cannot disregard a reappraisal of historical construction methods and techniques oriented toward bioclimatic performance. The Guidelines underscore the potential for collaboration with so-called climatic drivers in this process (A.T.T.E.S., 2010). While the current trend toward hyper-efficient mechanical systems works primarily as a compensatory strategy, enhancing passive performance—even during the design phase—constitutes a virtuous and desirable practice that fosters better integration between the building and its environment (A.T.T.E.S., 2010).

The ATTES document also addresses the regional characteristics of historic Venetian architecture. Its discussion of the construction materials used in regional and local historic buildings (A.T.T.E.S., 2010 examines stone, brick, lime and mortars, wood, metals, and transparent elements. The text contextualizes each material and describes its distinct types, examining their properties and use in historic buildings. Structural systems are broadly categorized into vertical and foundational elements, such as foundations, stone and brick masonry, mixed masonry, and partition walls—with particular attention given to the *scorzoni* (a method of constructing lightweight partition walls with thin stone slabs) and the *gradiz* (a traditional architectural element typical of the Belluno area). Other categories include horizontal structures, roofing systems, vertical circulation elements, interior and exterior staircases, flooring, plasterwork, roof coverings, and fixtures.

With specific reference to methodology for local historical heritage, these measures constitute a compendium of elements essential for a deeper understanding of construction. Only through rigorous and informed assessment can we adopt or reinstate the many devices that enhance the bioclimatic performance of historic buildings, with the primary goals of optimizing the design of mechanical systems and creating spaces that offer a higher degree of energy-related comfort.

What Should be assessed? Construction Techniques and Thermophysical Performance in Existing Buildings

A methodological approach to recovering the passive performance of architectural heritage can be structured in two phases: an analytical phase, which takes the study of the historic building as the basis for an informed intervention, and a synthetic phase, which formulates recommendations for interventions on historic buildings in line with principles of sustainability. The analytical phase involves examining the climatic zone and the responses embedded in the building's construction system. Gaining knowledge, therefore, starts first and foremost with a study of the surrounding context.

The reference context may be identified as urban, peri-urban, or rural, depending on the case. Within these settings one finds, respectively: characteristic structures of historic city centers, churches, and palazzos; buildings within established urban fabrics, such as small houses with gardens in peri-urban areas; small towns or rural settlements, and isolated units such as country estates, castles, monasteries, or Benedictine farmsteads.

Particular attention must also be paid to evaluating the relationship between climate and construction (Pracchi and Lucchi, 2013). Each climate makes it possible to identify specific measures for improving the thermophysical performance of existing buildings. This evaluative process applies not only to the systems within individual buildings but also, and more importantly, to urban centers and the way in which they are consolidated. While these solutions may appear self-evident, they remain fundamental.

In cold climates, houses are clustered together to reduce heat loss through conduction. Narrow streets frequently help limit wind penetration and intensity, and buildings are sited in areas sheltered by topographical relief. In temperate climates, one commonly finds compact urban structures designed to provide mutual shading between façades, streets oriented according to the prevailing wind direction, and porticoes, pergolas, and light-colored pavements. In hot, dry climates, settlements are carved into rock and buildings-oriented southeast to maximize solar exposure, while in hot, humid climates one typically finds long, narrow independent buildings with special emphasis on carefully designed roofing systems.

It is only at a later stage that these measures determine environmental variables at the scale of the built environment, maintaining a close tie to orientation and positioning of the buildings in relation to each other. In cold climates, the size of openings plays a fundamental role, combined with the use of double stonewalls whose cavities are filled with earth and straw to improve insulation capacity. Wooden cladding, usually dark in color, is also employed to raise surface temperature and enhance radiant heat transfer. In temperate climates, the structure of the Lombard farmhouse is typical: it is one of many examples of the use of common spaces and main east-west axes to optimize solar gain and day lighting. Within this typology, one also finds small but specific features, such as the so-called *porta morta*, an open passageway that functions as both an ideal boundary between different work areas and a device for maximizing shading and ventilation.

In hot, arid climates, there are numerous examples of finishes made with light-colored tiles, massive walls designed to achieve daytime cooling, or multi-directional ventilation systems meant to harness convective airflow. A very specific example of thermophysical adaptation is found in underground cities, where direct contact with the ground increases a building's thermal inertia. By contrast, in hot, humid climates, limited diurnal temperature variation reduces the need for the thermal inertia provided by massive walls and materials with good thermal capacity—such as wood, mats, latticework, and plant fibers—are common, along with adjustable shading devices like curtains or shutters, open façades to facilitate cross-ventilation, and frame structures enclosed by sliding panels. These strategies are exemplified in the traditional architecture of Japan (Pracchi and Lucchi, 2013; Buda, 2023).

Within a comprehensive understanding of historic architecture, thermal inertia has always played a key role—largely determined by wall mass. Strategies define case-specific relationships between form and surface-to-volume ratio. From a hygrometric perspective, the building envelope regulates the transmission of water vapor, with differing requirements in humid and dry climates. It also plays a role in ensuring comfort and environmental well-being, not only by regulating temperature but also by mediating air quality, wind, and sunlight.

In this delicate equilibrium, and through the interplay of architectural elements, each component of the building responds to climatic conditions with distinct regulatory functions. The difference between modern and historic buildings is well illustrated in figure 1, which shows the role all historical building components had in defining the best possible conditions for well-being, with particular reference to heating, cooling, and air circulation.

Authoritative examples of passive strategies can be found throughout the history of architectural theory and practice. As already noted: "Vitruvius, in the preface to Book VII of *De Architectura*, recommends the use of *cocciopesto* to a height of three feet above the floor, or the construction of ventilated counter-walls in more severe cases, along with hypocausts—ideally both ventilated and heated. The same solutions, together with the excavation of external cavities and drainage trenches, and the management of rainwater, including its diversion away from the building (through dispersal wells, channels, etc.), remained relevant and were consistently employed until the mid-nineteenth century (Aveta 1996)" (Pracchi 2009).

Similarly, Cavalieri San Bertolo documents restoration techniques aimed at preventing rising damp through material impregnation.

"In the second half of the nineteenth century, new solutions emerged through scientific experimentation, focusing primarily on the impregnation of stone materials with waterproof mastics or varnishes (…) as reported chiefly by Sacchi (1851) and Curioni (1878), on the construction of raft foundations using hydraulic lime concrete, and on the crawl spaces proposed by Lenti (1891) with tar coatings and compressed clay cavities beneath floors and behind walls in contact with soil. Techniques also included the mechanical cutting of masonry to insert lead sheets, layers of resin-impregnated charcoal, and chemical barriers made from 'liquefied mastic,' a compound of boiled linseed oil, wax, and litharge" (Cavalieri di San Bertolo, 1831). (Figure 2)

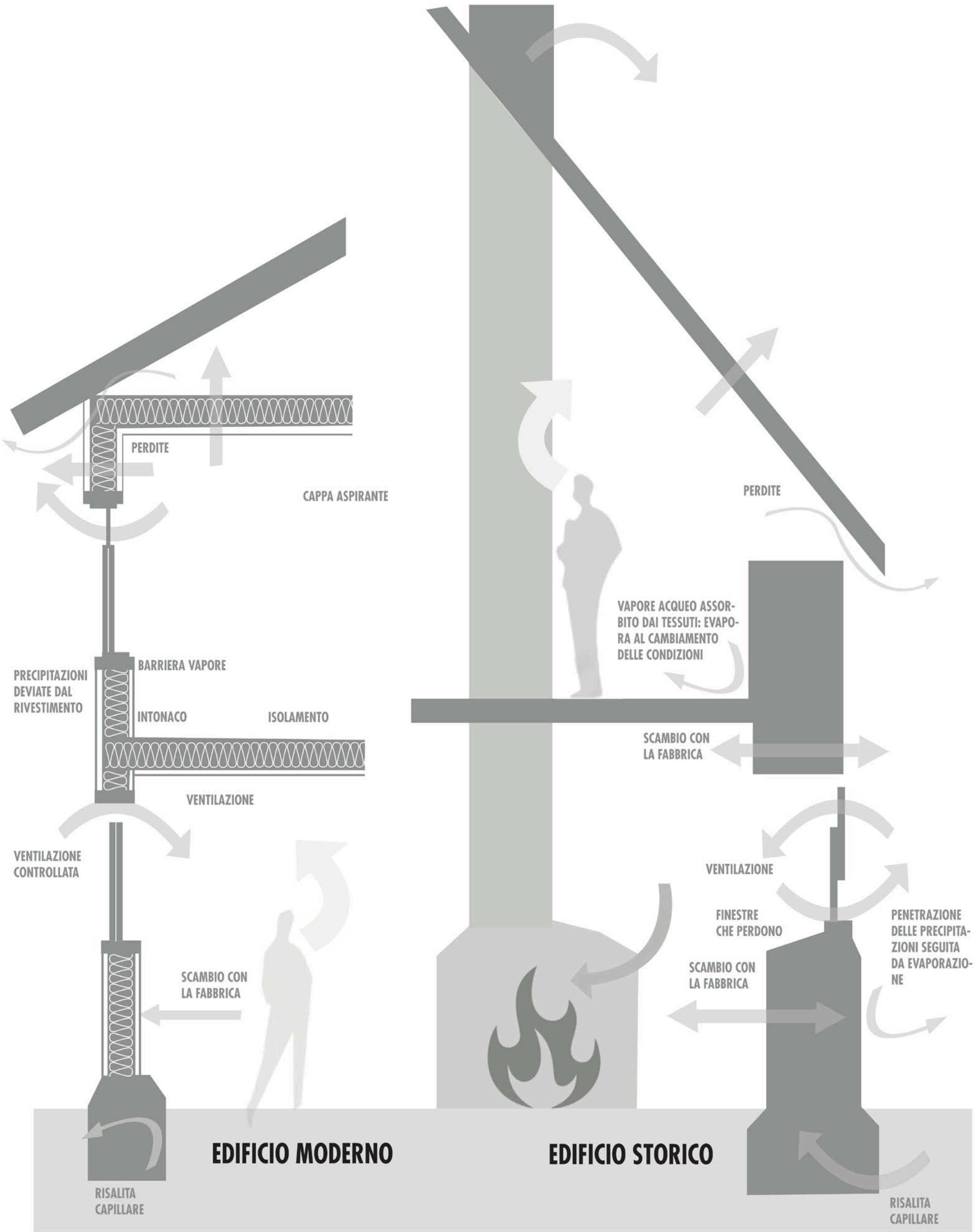

Figure 1. *Redrawn from: Robin Pender, English Heritage, 2008, in E. Lucchi, V. Pracchi (eds.), Efficienza energetica e patrimonio storico: la sfida del miglioramento delle prestazioni nell'edilizia storica, (Energy efficiency and historical heritage: the challenge of improving performance in historic buildings), Politecnica, Maggioli editore, Santarcangelo di Romagna, Robin Pender, 2013*
Vector drawing by Caterina Redana, 2024. [Translation of the figure captions. Left: 'modern building': leaks, extractor hood, precipitation deflected by the cladding, vapor barrier, plaster, insulation, ventilation, controlled ventilation, exchange with building fabric, capillary rise. Right: 'historic building': leaks, water vapor absorbed by the building fabric: evaporates when conditions change, exchange with the building fabric, ventilation, leaky windows, precipitation penetration followed by evaporation, exchange with the building fabric, capillary rise.]

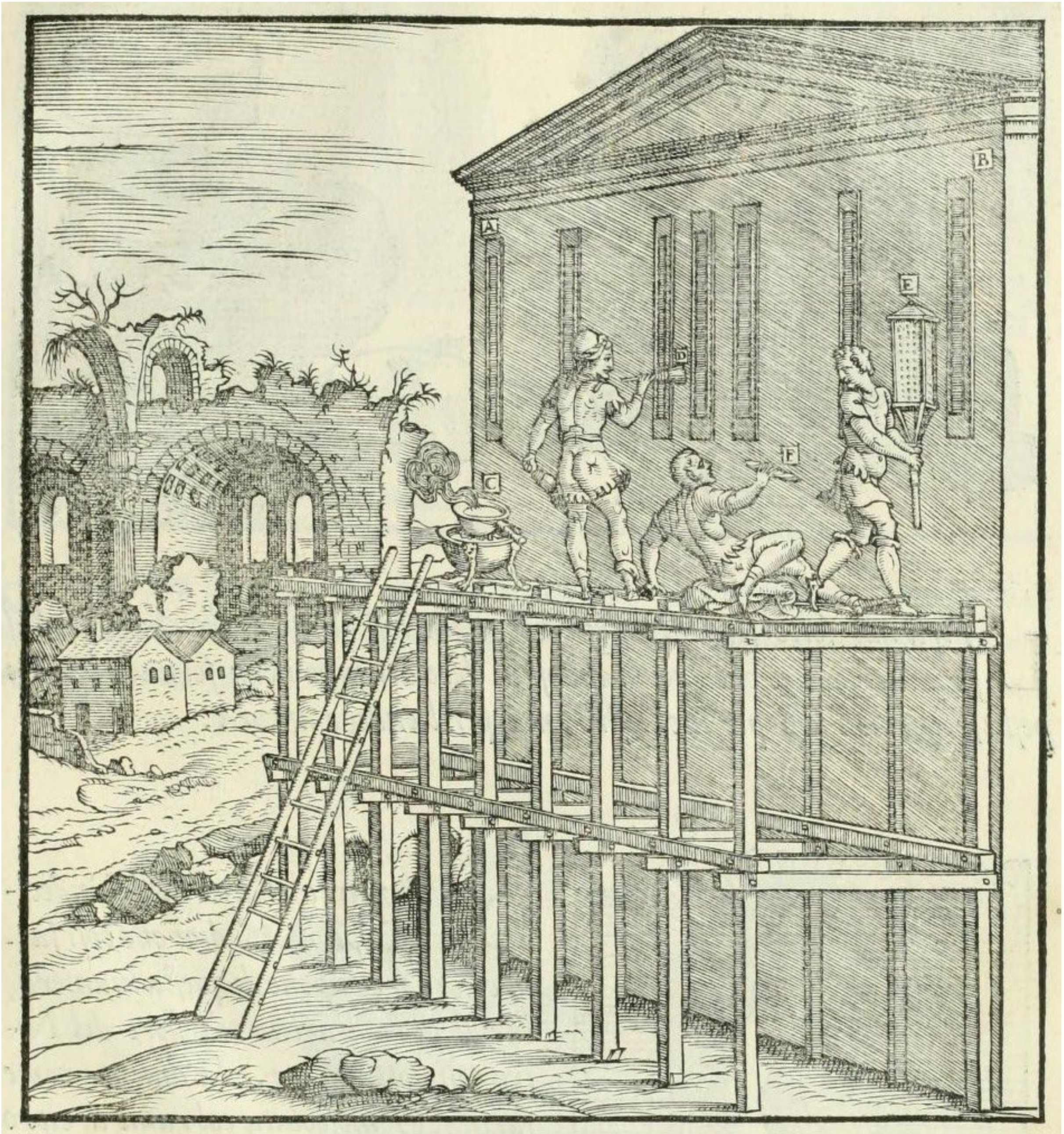

Figure 2.
Source: https://archive.org/details/dellaarchitettvr00rusc/page/46/mode/2up, Rusconi Giovanni, 1520

These age-old techniques remain relevant today because they shed light on how buildings functioned prior the advent of thermal technologies.

Historical solar and ventilation systems also deserve attention as early antecedents to modern renewable energy solutions. Among the solar collection systems documented historically are devices designed to harness the greenhouse effect for passive thermal storage. This category includes light chimneys created from existing shafts or new conduits, which channel solar radiation indoors through south-facing or overhead collection systems. Ventilation chimneys belong to same category: passive systems in use since antiquity. By making use of existing shafts or stairwells, the chimney effect exploits the temperature differential between indoor and outdoor air to expel stale air from interior spaces.

One of the most significant examples of this technique is Palazzo della Zisa, built in Palermo in the twelfth century. The building was oriented so that the sea breezes coming off the water could pass through the arches and windows of its facade lending a greater sense of freshness inside the building during the summer. The interior spaces were also positioned to benefit from a continuous air circulation system induced by strategically placed air ducts and windows. (Figure 3)

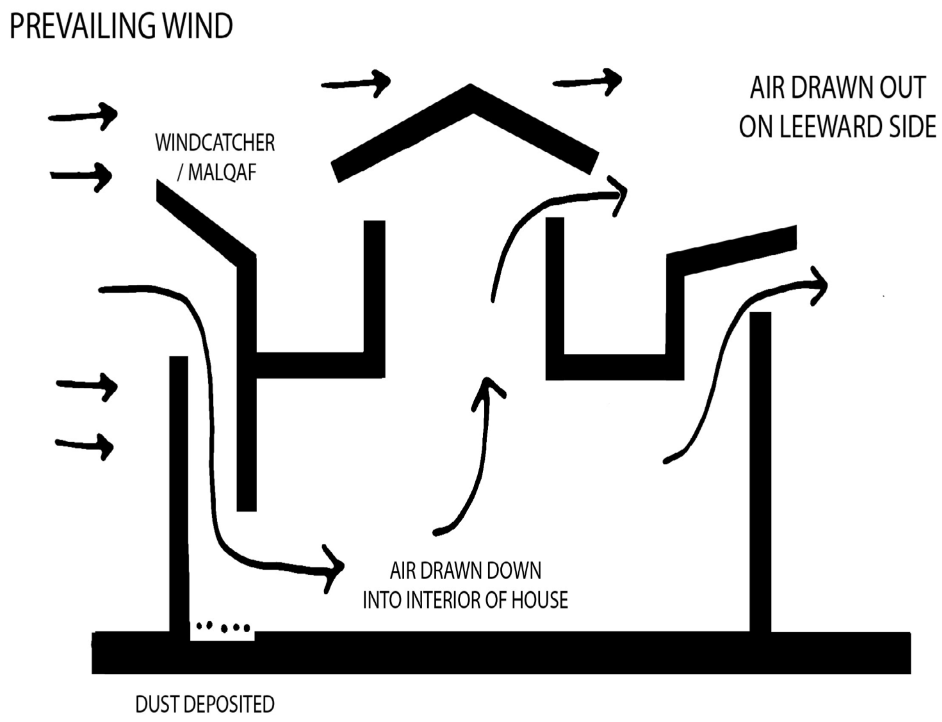

Figure 3. *Malqaf - Category: Windcatchers - Wikimedia Commons; left ® Le Tour du monde - 13 (356, crop) - Category: La Zisa (Palermo) – Wikimedia Commons*

In recent years, the study of passive building performance has gained attention within the framework of environmental protocols. Particularly relevant is the Historic Building Protocol developed by the Green Building Council Italy (2016).

GBC Historic Building is a voluntary certification protocol that assesses the sustainability of interventions on historic structures built before 1945. It applies to projects aimed at conservation, rehabilitation, restoration, and adaptive reuse. The protocol guides technical choices by prioritizing performance-enhancing solutions for the building envelope, while ensuring compatibility with the preservation of structure's historically significant characteristics.

GBC HISTORIC BUILDING® - CHECK LIST

YES	?	NO	Historic Value	Maximum score:	20
YES			Prereq. 1	Preliminary analysis	Mandatory
			Credit 1.1	Advanced analysis: energy audit	1 - 3
				I Level Analysis	*1*
				Advanced analysis: thermography	*2*
				Advanced analysis: thermography and thermic conductance	*3*
			Credito 1.2	Advanced analysis: diagnostic tests on materials and degradation	2
			Credito 1.3	Advanced analysis: diagnostic tests on structures and structural monitoring	1 - 3
				Diagnostic tests on structures	*1 - 2*
				Diagnostic tests on structures and structural monitoring	*2 - 3*
			Credit 2	Project reversibility	1 - 2
			Credit 3.1	Compatible end-use	1 - 2
			Credit 3.2	Chemical and physical compatibility of integrated materials	1 - 2
				Compatibility evaluation with fulfillment of the basic requirements	*1*
				Compatibility evaluation with fulfillment of the basic requirements and at least two complementary requirements	*2*
			Credit 3.3	Structural compatibility	2
			Credit 4	Sustainable restoration site	1
			Credit 5	Scheduled maintenance plan	2
			Credit 6	Specialist in restoration of architectural heritage and landscape	1

SI	?	NO	Sustainable Sites	Maximum score:	13
YES			Prereq. 1	Construction activity pollution prevention	Mandatory
			Credit 1	Brownfield redevelopment	2
			Credit 2.1	Alternative transportation: public transportation access	1
			Credit 2.2	Alternative transportation: bicycle storage and changing rooms	1
			Credit 2.3	Alternative transportation: low-emitting and fuel-efficient vehicles	1
			Credit 2.4	Alternative transportation: parking capacity	1
			Credit 3	Site development: open spaces recovery	2
			Credit 4	Stormwater design: quantity and quality control	2
			Credit 5	Heat island effect: non-roof and roof	2
				Outdoor paved surfaces	*2*
				High reflentance roofs	*2*
				Vegetated roofs	*2*
				Combination of high reflectance roofs and vegetated roofs	*2*
			Credit 6	Light pollution reduction	1

YES	?	NO	Water Efficiency	Maximum score:	8
YES			Prereq. 1	Water use reduction	Mandatory
			Credit 1	Water efficient landscaping	1 - 3
				Outdoor or irrigation water consumption reduction 50%	*1*
				Outdoor and irrigation water consumption reduction 50%	*2*
				No irragation required	*3*
			Credit 2	Water use reduction	1 - 3
			Credit 3	Water metering	1 - 2
				Mixed use building separated water meter	*1*
				High efficiency appliances and process water systems	*1*

YES	?	NO	Energy & Atmosphere	Maximum score:	29
YES			Prereq. 1	Fundamental commissioning of building energy systems	Mandatory
YES			Prereq. 2	Minimum energy performance	Mandatory
YES			Prereq. 3	Fundamental refrigerant management	Mandatory
			Credit 1	Optimize energy performance	1 - 17
				Procedura semplificata per la determinazione della prestazione energetica dell'edificio	*1 - 3*
				Simulazione energetica in regime dinamico dell'intero edificio	*1 - 17*
			Credit 2	Renewable energies	1 - 6
			Credit 3	Enhanced commissioning	2
			Credit 4	Enhanced refrigerant management	1
			Credit 5	Measurement and verification	3

YES	?	NO	Materials & Resources	Maximum score:	14
YES			Prereq. 1	Storage and collection of recyclables	Mandatory
YES			Prereq. 2	Demolition and construction waste management	Mandatory
YES			Prereq. 3	Building reuse	Mandatory
			Credit 1	Building reuse: maintaining existing technical element and finishing	3
			Credit 2	Demolition and construction waste management	1 - 2
				Reduction of 75%	*1*
				Reduction of 95%	*2*
			Credit 3	Materials reuse	1 - 2
				Reused materials for the 15%	*1*
				Reused materials for the 20%	*2*
			Credit 4	Building product environmental optimization	1 - 5
				Third part certification	*2*
				Multicriteria certification	*1 - 3*
			Credit 5	Regional materials	1 - 2

YES	?	NO	Indoor Environmental Quality	Maximum score:	16
YES			Prereq. 1	Minimum indoor air quality performance (IAQ)	Mandatory
YES			Prereq. 2	Environmental Tobacco Smoke (ETS) control	Mandatory
			Credit 1	Air monitoring	2
			Credit 2	Outdoor air delivery monitoring	2
			Credit 3.1	Construction IAQ management plan: during construction	1
			Credit 3.2	Construction IAQ management plan: before occupancy	1
			Credit 4.1	Low-emitting materials: adhesives and sealants	1
			Credit 4.2	Low-emitting materials: paints and coatings	1
			Credit 4.3	Low-emitting materials: flooring systems	1
			Credit 4.4	Low-emitting materials: composite wood and agrifiber products	1
			Credit 5	Indoor chemical and pollutant source control	1
			Credit 6.1	Controllability of systems: lighting	1
			Credit 6.2	Controllability of systems: thermal comfort	1
			Credit 7.1	Thermal comfort: design	1
			Credit 7.2	Thermal comfort: verification	2

YES	?	NO	Innovation in design	Maximum score:	6
			Credit 1	Innovation in design	1 - 5
			Credit 2	GBC Accredited Professional	1

YES	?	NO	Regional priority	Maximum score:	4
			Credit 1	Regional priority	1 - 4

			Total	Maximum score:	110

GBC Historic Building® - 2016 Edition

100 points; 10 bonus points for Innovation in Design and Regional Priority

Certified 40 - 49 points **Silver** 50 - 59 points **Gold** 60 -79 points **Platinum** 80 and more

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Figure 4. *GBC Historic Building® Check List*

The evaluation system is organized into several thematic areas: Historical Value (HV), Sustainable Sites (SS), Water Efficiency (WE) /Water Management (GA), Energy and Atmosphere (EA), Materials and Resources (MR), Indoor Environmental Quality (QI), Innovation in Design (IP), Regional Priority (PR). Taken together, these categories measure sustainability in the restoration process by translating areas of analysis into specific requirements applicable to the existing building. (Figure 4)

A noteworthy feature of this protocol is the recognition of historical value as the primary attribute of the building undergoing intervention. Among the sustainability criteria introduced is the urban heat island effect, which is influenced by external surfaces and roofing materials. In parallel, the UNI EN ISO 13790:2008 standard identifies the parameters that define a building's overall energy balance.

While the importance of material selection and construction techniques is now widely acknowledged, many sources highlight a significant lack of certification and diagnostic procedures specifically tailored to heritage buildings. All too often, these protocols appear to have been formulated for newly constructed buildings. Although this study does not enter into the specifics of performance metrics or calculations, it does underscore the importance of conducting preliminary investigative phases prior to implementing energy efficiency measures on historic structures—studies that can identify passive performance indicators and integrate them into restoration strategies while also informing approaches to new construction.

Conclusions

In historic architecture, buildings maintained a strong relationship with their geographical context. The concept of a passive building was closely linked to the energy performance of its envelope, achieved without reliance on mechanical heating or cooling devices.

Today's buildings rely on mechanical systems to compensate for climatic variations. In the past, however, builders adapted their solutions to the local context, drawing on elements such as location, orientation, roof pitch, shading systems, external surface color, and the size and placement of openings all played a fundamental role. Awareness of these features is vital, both for recognizing and preserving them as cultural values and for using them as resources to improve energy efficiency, conserve materials, and reduce waste.

Several studies and guidelines from the Ministry of Culture and other institutions have recently focused on sustainable development, with particular attention to historic buildings and bioclimatic architecture. These initiatives do not seek to exclude mechanical building systems but rather to emphasize the characteristics of historic structures as valuable elements that can inform efforts to improve energy performance.

Intervening on historic buildings—whether or not they are subject to cultural restrictions—first requires identifying how their original energy systems functioned, in order to preserve what remains of their passive performance, such as orientation to sun and wind, the use of natural light, and shading systems. This entails reviewing historic construction methods and techniques relevant to bioclimatic performance. For historic structures, the current trend toward super-efficient systems can, at least in part, be replaced by passive operation that reflects the traditional relationship between the building and its environment.

The theme of regional characteristics in historic buildings emerges through unique solutions that reflect local traditions. These include the use of stone, brick, lime and mortar, wood, metal and transparent elements, often shaped by building regulations. Each solution carries historical value for the built environment and may also provide useful insights for improving energy performance.

Identifying and understanding these aspects is essential for gaining a deeper knowledge of a building. This awareness allows the values of historic architecture to be carried into the present to support energy efficiency and sustainability objectives.

Acknowledgment

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