

# Remembering Heat: Bodies, Buildings, and Public Space in a Warming World

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What makes you comfortable?  
Are you feeling comfortable right now?

You are likely reading this text in a space with a stable temperature and a moderated indoor climate. Does the room ask you to shift your body, adjust your clothing, or open a window?

Rising global temperatures are rapidly transforming how thermal comfort is produced, distributed, and imagined. In urbanized, high-income contexts, HVAC (heating, ventilation, and air conditioning) systems have become the dominant model for achieving comfort. In a warming world, cooling is especially critical. Roughly two billion air conditioning units are now in operation worldwide, making space cooling one of the leading drivers of rising electricity demand in buildings, with energy consumption increasing by more than 5% annually in recent years (International Energy Agency, 2023). These energy-intensive infrastructures reshape not only buildings but also the habits and thermal expectations of their inhabitants.

Access to cooling, however, is highly uneven. While environments in the Global North are increasingly equipped with cooling technologies, others remain exposed to rising temperatures. Only around 5% of households in sub-Saharan Africa have air conditioning, compared with more than 85% in Japan, Korea, and the United States. In Germany, approximately 3% of households own air conditioners, reflecting limited demand in temperate climates (International Energy Agency, 2023). In Serbia, roughly 41% of households have an air conditioner, with urban ownership at 51% compared with 23% in rural areas (Statistical Office of the Republic of Serbia & UNICEF, 2021). Thermal comfort is therefore unevenly distributed, reflecting both economic capacity and geopolitical position.

Long before modernism and its global spread made cooling a mechanical service, societies developed architectural forms, bodily adaptations, and interventions in open space to negotiate temperature differences. These practices did not eliminate climate but mediated it. Where can we find the knowledge of living with heat? In the material of a wall, the rhythm of a day, the detail of a window? How might revisiting this knowledge open alternative imaginaries of comfort in a warming world? How do architecture and the body become mediums through which climatic knowledge is accumulated, transmitted, transformed, and thus negotiated and mediated?

## **Comfort in Architectural Theory**

Historically, comfort was understood as a constructed and culturally mediated norm that reflects specific material, economic, and social conditions. Thermal comfort was achieved through localized heating sources such as fireplaces, with people moving between rooms depending on the time of day or season, and occupying warmer or cooler spaces as needed. In warmer climates, passive cooling techniques created habitable environments, and comfort emerged from spatial practices, building techniques, and everyday habits. In modern architecture, comfort has been treated as a primary design objective. Since the early twentieth century, buildings have increasingly standardized indoor environmental conditions.

In recent years, scholars have questioned the dominant concept of comfort in modern architecture. Architectural historian Daniel Barber highlights the interconnectedness of architecture, climate, and energy, showing how reliance on fossil fuels has shaped contemporary building practices (Barber, 2023). As he states: “Comfort is a construct. Many new commercial and institutional buildings built over the past few decades rely so heavily on fossil-fueled mechanical HVAC systems that they would be uninhabitable without them”

(Barber, 2023, p. 1). He further argues for a reduction in technological control alongside a transformation of cultural expectations regarding comfort.

### **Standardized Thermal Comfort**

While comfort is about the general relationship between the body and the environment, including individual preferences and subjectivities, it has been scientifically defined, quantified, and universally applied in the built environment and policy. Technical standards developed by expert organizations specify the comfort zone, i.e., the environmental parameters under which a space is considered “thermally comfortable.” The international standard ISO 7730 defines the comfort zone through measurable criteria such as air temperature, radiant temperature, humidity, and air velocity. For a typical office environment, the standard specifies that the air temperature should range between approximately 20–26 °C in winter and 23–28 °C in summer, with relative humidity generally recommended between 30–70% (ISO, 2005).

These standards were developed based on laboratory models that assume an “average” human body. Typically, this reference subject was defined as a male adult and became the normative baseline for thermal regulation. Such universalization overlooks important variations in age, gender, metabolism, culture, and climatic context. For instance, research shows that women, on average, prefer indoor temperatures 1–3 °C higher than those preferred by men (Nicol & Humphreys, 2002). By treating this male-coded standard as the default, universal comfort norms embed structural biases without taking into consideration the diversity of human bodies and experiences. In practice, this means that conditioned interiors designed according to ISO standards often do not reflect the needs of the population. Recognizing these limitations opens the way for adaptive thermal comfort models, which consider behavioral, cultural, and physiological variation rather than enforcing a rigid, one-size-fits-all ideal.

### **Adaptive Thermal Comfort**

In contrast to static models and DIN norms, the theory of adaptive thermal comfort, developed by Richard de Dear and Gail Brager in 1998, recognizes that comfort depends not only on measurable physical conditions but also on behavioral, cultural, and psychological factors. Instead of prescribing a single ideal temperature, the adaptive model acknowledges that people continuously adjust to their environment, and thermal comfort is therefore understood as dynamic and relational. It develops through lived experience, expectation, and habit. Individual bodies respond to heat or cold by modifying clothing, adjusting windows, altering activity levels, or simply recalibrating their expectations (de Dear & Brager, 1998).

This perspective is closely linked to the physiological principle of homeostasis, the body’s capacity to regulate its internal state. In thermal terms, this refers to maintaining a core temperature of approximately 37 °C through processes such as sweating or shivering in response to external conditions. Adaptive models recognize these physiological mechanisms but extend beyond them, emphasizing that comfort is co-produced by bodily regulation, learned adaptation, and environmental interaction (Osilla et al., 2023).

Adaptive thermal comfort also has direct implications for energy use and climate. By acknowledging that people can adapt to a wider range of temperatures through behavioral practices, buildings can reduce reliance on mechanical cooling or heating. This perspective links adaptive comfort theory directly to the critique of carbon-intensive, mechanically conditioned interiors (de Dear & Brager, 1998; Osilla et al., 2023).

### **The Archive of Heat Adaptation**

From this perspective, knowledge of how to cope with heat can be found embedded in bodies and the built environment, forming an archive of experiential thermal adaptation. This archive connects past and present, transmitting thermal knowledge across generations and climates. It offers a counter-narrative to standardized, universal comfort norms that assume a non-existent “average body.”

This essay adopts a qualitative and interpretative approach to explore how thermal knowledge is embedded in everyday practices and built environments. Rather than measuring thermal performance quantitatively, we investigate how knowledge of living with heat has been produced, stored, and transmitted across time and space. Our research is exploratory by design, focusing on patterns, meanings, and forms of knowledge that are often overlooked.

We work primarily with existing scholarship and case studies to understand how people historically built and inhabited spaces in hot climates and how these strategies are interpreted today. Following the adaptive thermal comfort model, thermal comfort is also produced by humans. Therefore, we examine not only the buildings themselves but also the routines, habits, and social practices that made cooling effective. Our approach is synthetic: we draw connections across different sources, geographies, and time periods to identify recurring strategies and underlying principles.

Examples were selected to represent diverse geographies, climates, and historical periods. We prioritized cases that span different scales to understand how thermal knowledge operates in different social contexts. Finally, we focused on strategies that remain relevant today, particularly in our local contexts in the Global North.

Analysis is structured around three categories that together constitute a cultural ecology of cooling: Bodies, Buildings, and Public Space. Bodies refers to embodied habits, routines, and sensory adaptations, how individuals learn to read and respond to thermal conditions through daily practice. Buildings encompass the material and spatial strategies through which architecture mediates climate. Public space addresses the urban dimension of thermal adaptation. These categories are interconnected, buildings shape bodily habits, public spaces reinforce social practices, and embodied experience informs design. Together, they offer a decentralised and situated approach to the challenge of global warming.

### **Bodies: Embodied Knowledge of Living with Heat**

Before the invention of mechanical cooling, humans actively negotiated their thermal environments through their bodies—not as passive recipients of climate, but as adaptive, learning entities capable of interpreting heat and cold and responding in ways that preserved comfort and health. This embodied knowledge was acquired gradually in daily life through movement, rest, exposure to sun or shade, and interaction with the built environment.

### **Clothing: Layers of Adaptation**

Clothing represents one of the most immediate forms of adaptive thermal behavior. Garments act as extensions of the body, mediating the flow of heat and moisture and enabling humans to inhabit specific climates more comfortably.

In the Mediterranean, for example, linen is widely used for summer clothing. Linen fibres are made from flax, one of the oldest textile plants in human history. The fibres are extracted from the stem and used to produce linen fabric. They can absorb up to 20% of their weight in moisture before feeling damp. Sweat is absorbed away from the skin while allowing air to circulate. As moisture evaporates from the fabric, it produces a cooling effect (evaporative cooling), contributing to the body's natural thermoregulation process.

Comparable strategies appear in other climatic regions, reflecting their specific environmental conditions and cultural practices. In the Middle East and North Africa, loose

garments such as the djellaba or thobe create a layer of air between the body and the fabric, promoting ventilation while protecting the skin from direct sun. Light-colored fabrics further reduce heat absorption by reflecting sunlight (Parsons, 2014). Similarly, in South Asia, lightweight cotton garments such as the kurta or sari facilitate airflow and allow moisture to evaporate in humid climates (Havenith, 2002). In desert regions of North Africa, Tuareg communities traditionally wear layered cotton robes and veils that cover most of the body. Although this may appear counterintuitive in extreme heat, the layered fabric protects the skin from intense solar radiation and reduces water loss by limiting direct exposure to hot, dry air (Shkolnik et al., 1980).

Merino wool offers another interesting example because, unlike linen, it performs in both hot and cold conditions. Its fibres are exceptionally fine, typically 17–24 microns in diameter, making them soft against the skin and comfortable to wear, unlike other types of wool that can feel itchy. Its structure contains tiny air pockets that trap heat in cold conditions while still allowing airflow to prevent overheating in warm conditions. The fibres also have excellent moisture management properties and can absorb up to 30% of their weight in water.

Clothing thus functions as a layered system of adaptation. People adjust garments according to the time of day, season, or activity level, creating a dynamic microclimate around the body. Here, thermal comfort is actively co-produced through bodily engagement and material culture. Clothing becomes a medium for mediating temperature, and over time, repeated interaction with such practices trains the body to sense environmental changes, anticipate discomfort, and develop resilience to heat.

### **Modern Interiors: The Passive Body**

The transition to modern climate control did not only standardise comfort but also reorganised the relationship between the body and the environment. While vernacular strategies reacted to differences in temperature, modern interiors aimed to isolate and stabilise conditions. The body was no longer expected to adjust, instead, interior climates were designed to maintain constant conditions and eliminate changes.

This shift transformed the temporal structure of everyday life. Climate-sensitive breaks like slowing down and resting in hot climates structured activity during the day. Practices such as the Mediterranean Siesta are not only cultural inventions but an adaptive response embedded in climate conditions. In Spain, usually between 1pm and 4pm when temperatures are the highest, many shops close in the early afternoon and people go home, eat lunch and take a break. Work and social activities then continue later in the evening. With the rise of mechanical cooling and new work models, such rhythms became increasingly misaligned with productivity expectations and traditional midday breaks became impractical. For urban workers in industrialized contexts, these long pauses are now viewed less as a physiological necessity and more as an inconvenience that conflicts with modern work schedules (Sánchez-Moreno & León, 2015).

In this process, adaptation migrated from the body to the building. The regulated thermal environment reduced the need for bodily calibration and physiological responsiveness became externalised. The body's sensory engagement with fluctuating conditions became secondary and the modern interior subtly redefined the human relationship to climate.

Research in human thermophysiology shows that heat tolerance develops through repeated exposure, improving cardiovascular efficiency and sweat response (Parsons, 2014). The thermal consistency of climate-controlled environments narrows the body's adaptive capacity: the "passive body" is not biologically inactive, but less practiced in adjusting to regulate comfort. When variation disappears, sensitivity intensifies. Minor fluctuations are experienced as discomfort. Thereby, mechanical cooling displaces the experiential and embodied knowledge that humans once acquired through direct engagement with their

environment (de Dear & Brager, 1998; Nicol & Humphreys, 2002). Can we see the body as a living archive of thermal experience, storing adaptation strategies for negotiating heat?

Understanding the body in this way establishes a conceptual bridge to buildings and open spaces, where thermal knowledge is similarly encoded in materials and spatial design.

### **Buildings: Material Knowledge of Living with Heat**

In the following section, we focus on three architectural strategies for dealing with heat, each addressing a different dimension of thermal adaptation. Thermal mass stores and releases heat through materials. Solar control blocks radiation before it enters. Transitional spaces create gradients that allow occupants to modulate exposure. By tracing them from vernacular origins to contemporary versions, we follow how thermal knowledge persists across climate zones and times.

#### **Thermal Mass: Material Memory**

In regions with high daily temperature differences like the Mediterranean, the Middle East, North Africa, and American Southwest, thick walls made of stone, brick, adobe, or rammed earth regulate indoor temperatures through the material properties. These walls act as a heat reservoir and work with temporal delay, slowly absorbing heat during the day and releasing it at night. Traditional Moroccan kasbahs or Greek island houses make use of that principle: the walls provide warmth to interiors during cool nights and buffer heat during hot days, integrating material logic with daily rhythms of inhabitants (Rapoport, 1969; Fathy, 1973).

This principle remains relevant in contemporary architecture. Francis Kéré's Gando School in Burkina Faso (2001) uses compressed earth blocks and double-roof ventilation to create thermally stable classrooms without mechanical cooling. Similarly, Anna Heringer's METI School in Bangladesh (2006) demonstrates how thermal mass can mediate extreme temperature differences, combining vernacular principles with modern design approaches. As we can see, materiality itself can encode and transmit thermal knowledge, bridging historical and contemporary design strategies.

#### **Solar Control: From Vernacular Screens to Responsive Facades**

Across hot climates, solar control is achieved through a wide range of culturally specific architectural devices that mediate the sunlight before it reaches the interior. In Islamic architecture, mashrabiya screens, adjustable wooden shutters, filter sunlight into a pattern while allowing the air in. In South Asia, jali screens perform a similar climatic function through perforated stone or lattice structures that protect interiors from direct solar radiation while maintaining ventilation. Inhabitants adjust these devices daily by interactions, opening shutters at dawn, closing at midday and maintaining agency over thermal conditions. The brise-soleil, an external sun-shading device composed of horizontal or vertical fins that block direct solar radiation while allowing daylight and airflow, represents a moment when vernacular shading strategies were reinterpreted through architectural modernism. In projects such as the Ministry of Education and Health in Rio de Janeiro (1936–1943) and later in Chandigarh (1952–1958), Le Corbusier translated long-standing shutters into concrete sun-breakers integrated into the building façade. This approach became central to tropical modernism across Brazil and other warm countries (Barber, 2020).

In contemporary architecture, these principles are increasingly combined with technological innovations to create hybrid solutions. Earlier experiments already explored responsive solar control. Jean Nouvel's Institut du Monde Arabe in Paris (1987) reinterprets the traditional mashrabiya through a façade composed of mechanical diaphragms that open and close in response to changing light conditions. Similarly, EcoLogicStudio's Pho to.Synth.Etica installation in Dublin (EcoLogicStudio, 2018) employs algae-filled photobioreactors that

provide shading while simultaneously capturing CO<sub>2</sub>. These examples show solar control evolving from fixed architectural elements to systems that actively respond to environmental conditions.

### **Transitional Spaces: Threshold as Thermal Strategy**

In climates with seasonal variation, transitional spaces mediate between interior and exterior. These thresholds create thermal gradients rather than uniform conditions, allowing occupants to control sun, wind, and temperature exposure through position and seasonal use. The Indian veranda serves as a social space and thermal buffer in a similar way to the Mediterranean loggia. These spaces preserve a mode of inhabitation where occupants remain thermally aware by adjusting position in the space and using a space seasonally.

Lacaton & Vassal's winter gardens exemplify how this principle adapts to contemporary Northern European contexts. In Tour Bois-le-Prêtre, Paris (2005–2011), intermediary spaces allow occupants to interact directly with environmental gradients. Jean-Philippe Vassal describes this relationship in terms the body understands intuitively:

Operating the winter garden is quite similar to dealing with different layers of clothing. If it's a bit cool, you pull something over your shoulders. When it gets too hot, you take it off. If there's too much sun, you seek out shade...The regulation of the climate in the winter garden is very intuitive, unlike many mechanized systems. (Ruby et al., 2021, p. 34)

The winter garden revives loggia and veranda logics for temperate climates experiencing more frequent heat events.

Together, these architectural strategies and built solutions show that thermal knowledge persists across climate zones and historical periods. They preserve the ability to read climate through architecture and are directly linked to habitual practice and how these spaces are inhabited (Rahm, 2009).

### **Public Space: Collective Knowledge of Living with Heat**

Beyond the scale of the body and the building, thermal adaptation also takes place on an urban scale in public spaces and outdoor environments. These examples show how such strategies organise environmental conditions as well as the social use of space.

### **Water: Evaporative Cooling in Public Space**

Water plays a central role in public cooling. Evaporation cools the surrounding air because the transformation of water from liquid to vapor requires heat energy, which is absorbed from the environment. Adults often gather near fountains for the cooler air, while children use them for play and refreshment. In Mughal India, charbagh gardens use water channels and pools to structure airflow and social activity. It consists of intersecting water canals, often with a central fountain or basin. Flowing water cools the surrounding air through evaporation, while the linear water channels also guide movement through the garden, creating cooler zones where people gather, rest, or walk. In this way, water functions not only as an aesthetic element of the garden but also as a microclimatic infrastructure. In Mediterranean cities, public fountains are used to create evaporative microclimates. They continuously expose new water surfaces to the air to evaporate. Because people enjoy staying around these cooler zones, fountains often become natural gathering points where people sit, rest, and come together.

## **Courtyards: Ventilated Urban Interiors**

A similar microclimatic logic appears in the architecture of courtyards or plazas. In the historic city of Córdoba in Spain, traditional houses are organized around patios that function as mediating microclimates during hot Mediterranean summers. The courtyard is typically a semi-public space, surrounded by four sides that block direct sun for much of the day and, due to its spatial configuration, is very well ventilated. During the hottest hours of the day, the patio becomes the most comfortable part of the house. Beyond their climatic function, these courtyards also structure everyday life. Neighbors use the patio as a centre of their social life, for eating, resting, and gathering. The importance of the courtyards as a social space is celebrated in the annual Fiesta de los Patios de Córdoba, where residents open their courtyards to visitors and decorate them with flowers, fountains, and greenery. The same climatic principle appears across many hot regions. South Asian havelis and Moroccan riads, for example, organize houses around shaded interior courtyards as well.

## **Cool Pockets: Contemporary Public Thermal Infrastructure**

While courtyards and fountains represent historical forms of public thermal infrastructure, contemporary urban design is beginning to scale these principles to the city level. In the essay *Implementing Thermal Re-regulation in the Public Domain*, the concept of cool pockets demonstrates how vernacular strategies can inform urban interventions in extreme climates (Brearley & Zhang, 2025).

Cool pockets are urban cooling interventions that range from low-tech surface treatments to active systems such as fans or misting, adapting to site-specific resources. By focusing on cooling key locations only, cool pockets provide accessible external thermal comfort while avoiding unnecessary conditioning of entire urban areas. They are designed as part of a network to create a gradient of comfort across a pathway, neighborhood, or city at specified intervals. The idea centres on the human body and the factors that influence thermal exchange, including air temperature, humidity, airflow, metabolic rate, clothing, and individual physiological differences.

## **After Comfort?**

Thermal knowledge has not disappeared but has simply been displaced. The examples discussed show that it persists in habits, architectural forms and public spaces. To reactivate and access these archives is not to romanticise the past or to propose a return to pre-industrial ways of living. It is rather to question the assumption that comfort is delivered exclusively through stability and mechanical cooling.

Mechanical cooling offers reliability and immediacy, particularly in contexts of extreme heat where vulnerability is life-threatening. Yet its dominance narrows the spectrum of thermal experience and reduces the need for adaptive engagement. When interiors remain permanently stabilised, the body's capacity to negotiate warmth and cold diminishes and buildings lose their role in mediating temperature. Reactivating embodied and spatial knowledge introduces a productive tension. Instead of eliminating variation it accepts a broader comfort range and proposes adaptation to temperature as an active practice. If mediating temperature is something that is learned and practised, it can also be relearned through exposure and can rebuild tolerance and reestablish habits that mechanical systems have made temporarily unnecessary (de Dear & Brager, 1998).

It is important to emphasize that this argument does not imply rejecting technology altogether. Hybrid models may offer a viable path forward, combining vernacular climatic intelligence with contemporary performance standards. One illustrative example is the renovation of traditional houses in the Stara Planina region of Serbia. In Stara Planina, historic rural houses were originally designed with high thermal mass, compact volumes, deep eaves, and small openings that responded intelligently to local climate conditions.

Thick stone walls buffered indoor temperatures, orientation and shading modulated solar gain, and natural ventilation supported comfort without mechanical intervention. In recent renovation projects, these vernacular strategies were not replaced but upgraded. Contemporary insulation materials were introduced in ways that preserved the beneficial thermal inertia of the original fabric; window replacements improved airtightness while still allowing cross-ventilation; and mechanical systems such as targeted radiant heating were added selectively rather than as primary climate control. The renovation approach maintained climatic connectivity, the houses remain responsive to seasonal shifts, wind patterns, and solar exposure. In this hybrid model, architecture becomes layered and not sealed, adaptive and not absolute, while improving comfort and energy performance for contemporary use (Bošnjak, Jevtić, & Jovanović, 2023).

This layered approach suggests a reframing of the question. Instead of asking how to make cooling more efficient, we might ask how to reduce its necessity. Can buildings reintroduce gradients and layers of temperature? Ultimately, accessing historical thermal knowledge shifts the focus from control to participation. It positions comfort as a situated practice shaped by climate and culture. In this warming world, resilience may depend less on perfecting enclosures but on expanding our capacity to co-live with climate.

We opened by asking where the memory of living with heat has been stored and what forms of knowledge have been lost to mechanical cooling. The answer, we have argued, is that this knowledge was never lost. It persists in bodies, buildings, and public space, encoded in material form, spatial practices, and daily routines. Mechanical systems interrupted adaptation, making vernacular knowledge seem obsolete even as it remained legible in the built environment.

If this is true, then the place where we read these words, likely a mechanically conditioned interior, becomes part of the archive we are trying to recover. We should be honest about our position. This text was composed within such infrastructures, partly through dialogue with a language model running in continuously cooled data centers. The argument about thermal dependence cannot stand outside its own conditions of production. We write about cooling while depending on it.

The discomfort is and was always there.

These strategies work with it, distribute it, temporalise it, make it bearable.

What makes you comfortable?

Are you feeling comfortable right now?

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