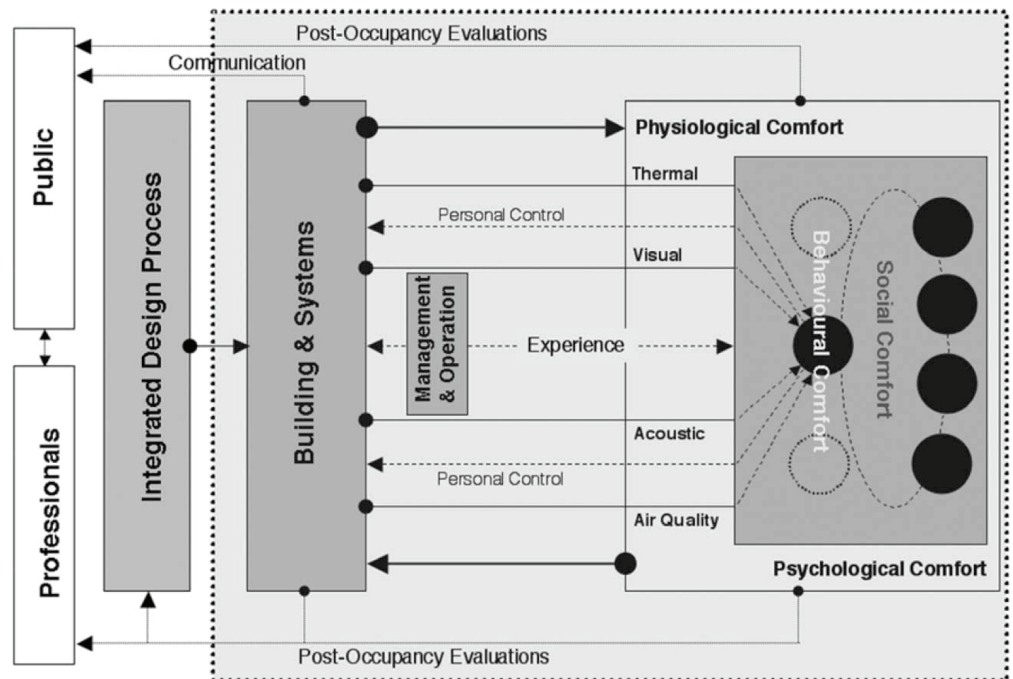# Regional and Historic Standards of Comfort

Jenna Kamholz and Lisa Storer

Regional and Historic Standards of Comfort

Jenna Kamholz
Lisa Storer

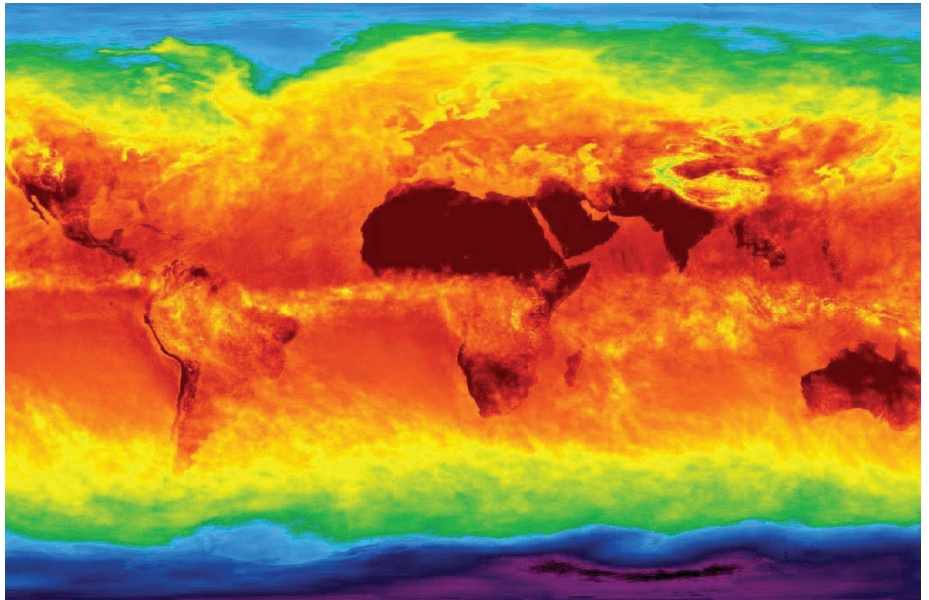Fig. 01   NASA map of variations of solar radiation that reaches Earth

Introduction

The definition of comfort is complex and varies widely when viewed from various disciplines ranging from engineering and architecture to physiology and psychology to social sciences and cultural anthropology.[1] When one views the idea of comfort through one lens (as the practicing architect tends to do), the amount of information is unsatisfactory at best and is almost guaranteed to be inadequate. Accepting the validity and complementary nature of these different comfort paradigms involves understanding that the notion of comfort has evolved through history, responding to various social, technological, economic, and cultural influences.[2] It is not static, and each new layer of meaning modifies and builds on the previous basis of knowledge regarding comfort.

Comfort can be defined as "that condition of mind which expresses satisfaction with the thermal environment".[3] Being relegated to a 'condition of mind', it is therefore a psychological phenomenon and not a physiological state - it is influenced by individual differences in mood, personality, culture, and other social factors. These issues are difficult to measure and therefore have not been incorporated into existing standards for indoor thermal comfort.

Generalizations of Comfort Standards

The concept of comfort is challenged by the process of standardization. Despite an industry-wide acceptance and utilization of recognized standards, reliable, universal, empircal data related to human comfort is difficult to gather. As *Mechanical and Electrical Equipment for Buildings* states, "The common experience of comfort is simply a lack of discomfort - thermally, of being unconscious of how you are losing heat to your environment."[4] This approach ignores the

complexity of comfort and all of its contextual and cultural influences, while the simple goal of creating 'thermal neutrality' in buildings hinders the possibility of creating indoor environments that are richer, more experiential, and have the ability to provide valuable sensory stimulation.

The complexities of comfort make it almost impossible to measure directly. Scientists have resorted to measuring only the physical variables that influence a body's heat exchange with the environment, asking questions about thermal sensation, and then making assumptions about satisfaction or dissatisfaction. Research in the field has followed two paths: laboratory-based methods (climate chambers) such as Fanger's famous PMV-PPD model and field-based research or a holistic person–environment systems approach such as the Adaptive Comfort Standard. The latest edition of ASHRAE's thermal comfort standard incorporates findings from both of these methods. However, much of the data underpinning international standards traditionally has come from labratory experiments which are now criticized for their use of relatively small samples of university students. Studies have shown consisentcy in comfort ratings between the chamber research and field research with centrally conditioned buildings but not in naturally ventilated buildings or where individuals play an active role in regulating their comfort.[5]

Furthermore, since discomfort is a more straightforward phenomenon to measure, in practice the engineering view of ideal comfort implies an absence of sensation, where a

Fig. 02 An example of a Japanese *kotatsu*.

perfect thermal environment is one that is never noticed at all.[6] By deliberately engineering our indoor environments to minimize thermal stimuli, we may very well be neutralizing our sensory receptors. Researchers dating back to the 1950s have found that sensory stimulation is important in our environments. As Heron stated in 1957, "A changing sensory environment seems essential for human beings. Without it, the brain ceases to function in an adequate way... Variety is not the spice of life: it is the very stuff of it."[7]

Comfort is not just an outcome of the physical environment; it is instead a complex perception that is constituted by the intersection of objective stimuli with cognitive and emotional processes. Building standards are the most influential mechanism for transferring information from research to practice, and quickly become institutionalized in a society as rules or norms.

Current international standards for thermal comfort, developed by

both ASHRAE and ISO, lack any recognition of cultural or regional differences in attitudes about comfort or preferences for specific thermal conditions. Ironically, while these standards were intended to improve the availability of technical information to everyone, they have essentially ignored the complex and multiple meanings of comfort. In particular, they disregard the contextual influences of behavior and expectations in forming our comfort preferences, and how the building itself influences these preferences. As a result, these standards are being universally applied often unnecessarily and inappropriately, further promoting the homogeneity of indoor environments.

Current Variations in Regional Definitions of Comfort

Cultural factors can influence attitudes about comfort and the design of comfort conditioning systems, such as the Japanese concept of people-conditioning rather than space-conditioning. There is a widespread and long-held cultural belief that it is wasteful to heat and

cool spaces that are not occupied. The traditional Japanese heating system is the kotatsu, a person heater placed under the dining table. This provides not only a utilitarian arrangement, but also a social one, and is linked to the preservation of the social bonds of the Japanese family. In terms of cooling, Japanese residential air-conditioners also follow the traditional focus on person-based conditioning. The controls of many of these systems are designed to perceive and respond to user preferences for comfort. The Japanese were also early adopters of 'task-ambient' air-conditioning systems where workers have individually controlled ventilation systems, even in interior zones of large office buildings.[8]

In opposition to American cooling systems which are almost exclusively temperature based and minimize air movement, the Japanese systems purposely use the term 'wind' to suggest a relationship between the person and natural environment, and their controls are designed from the perspective of the user's experience of the conditions rather than referring simply to the machine's 'fan speed'. These relatively sophisticated systems are designed to produce varying air movement patterns that mimic natural breezes inside the dwelling, where intense gusts are less frequent and shorter in duration than the gentle gusts. Some systems can even sense the location of people in the room to direct air toward them.

In contrast to the concept of a variety of air movement in order to achieve comfort levels in Japanese air-conditioning systems, some Scandinavian cultures avoid drafts or
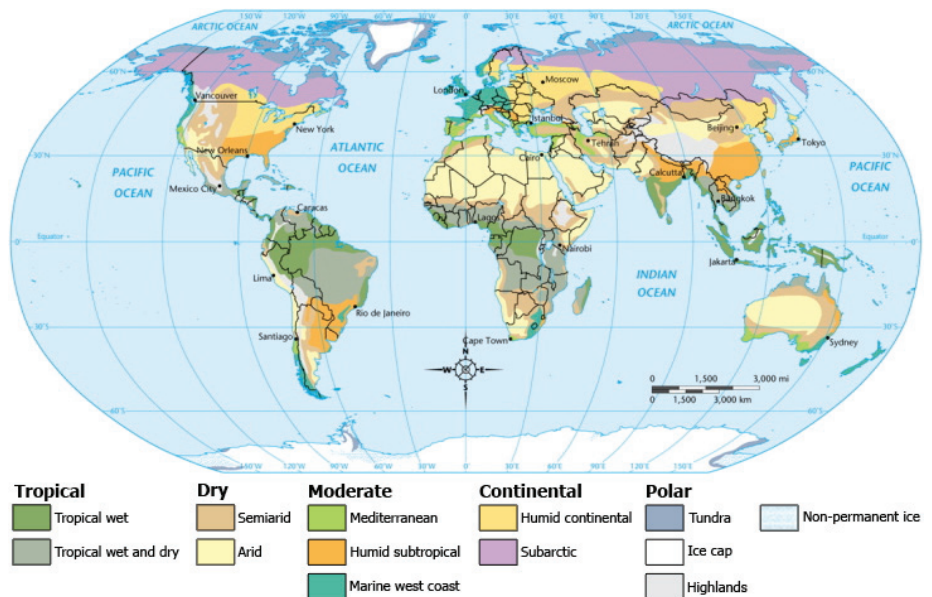

Fig. 03   The Earth's Climate Zones

unwanted air movements in indoor environments. Typically, a light silk or cheesecloth scarf has become daily modern casual office attire to fend off the draft. Interestingly, the 'draft risk equation' that appears in both ASHRAE and ISO comfort standards was developed in a Danish research study using Danish subjects, and has yet to be validated by another study elsewhere.

Historic Evolution of Comfort Expectations

Human kind has used various methods to achieve thermal comfort throughout history. Before modern thermal control technologies were available two key strategies were migration and mass. Many early cultures led nomadic lifestyles moving with the seasons to more hospitable locations. Others used buildings to create microclimates, widening the choice of thermal conditions. For example, the traditional Tunisian house is two

stories surrounding a courtyard. The interior rooms on the first floor are ideal during the summer days because the thermal mass and shading from the summer sun keeps them cool. In the summer evenings, the roof provides a place to release heat to the evening sky. The habitation patterns reverse in winter when the roof and upper loggia are the most hospitable during the day because they provided access to the sun, and the second story rooms radiating the heat from the day are the perfect place to spend the evening.[9] The other strategy often employed was the use of thermal mass to store warmth. "All the major civilizations…have demonstrably, and demonstratively, relied on the construction of massive buildings to fulfill their environmental needs, both physical and psychological."[10] Radiation was the main method of achieving comfort whether from the sun and by extension the mass of the building or from fire, making the hearth the focal point of the

home. With these methods there remained an expectation of swings in temperatures with the natural changes in the ambient conditions.

Throughout the history of the built environment, humans have habitually compensated for a large range of climatic conditions through various building techniques that are reflected in variations of vernacular architecture. Modifying the amount and location of thermal mass, openings for wind movement, and shading devices has allowed humans to successfully build, thrive, and daresay find 'comfort' in environmental conditions far outside the ranges provided by today's thermal comfort standards.

The Advent of Mechanized Thermal Conditioning

The definition of comfort has changed over time as new technologies and strategies gave people greater control over their immediate environment. Initially, comfort meant only, "that conditions were merely tolerable or sufficient, ample but not luxurious… It wasn't until the nineteenth century that the term was first used to refer to environmental comfort related to light, heat and ventilation."[11] The idea of sufficiency has persisted, yet people did not speak about comfort in quantitative terms until the technologies for thermal control were developed and widely available.

The first technology that dramatically changed the way people understood how buildings could provide comfort was the Franklin stove, which allowed a house to be heated indirectly by heating the air and then circulate it to keep people warm. "Its
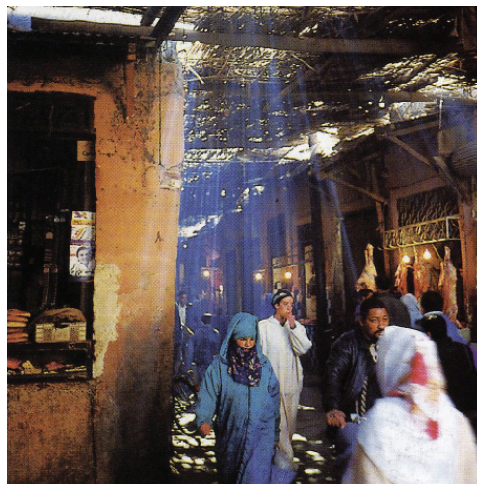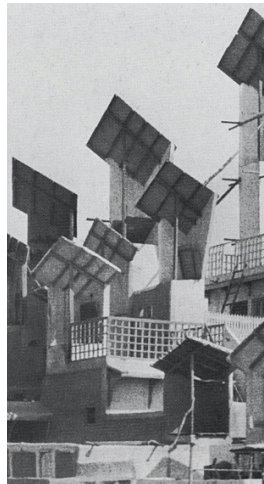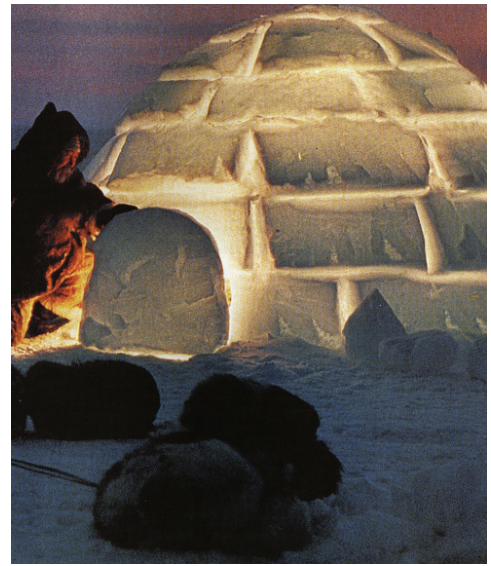

Fig. 04   Various vernacular building strategies for providing comfort within varying climate zones
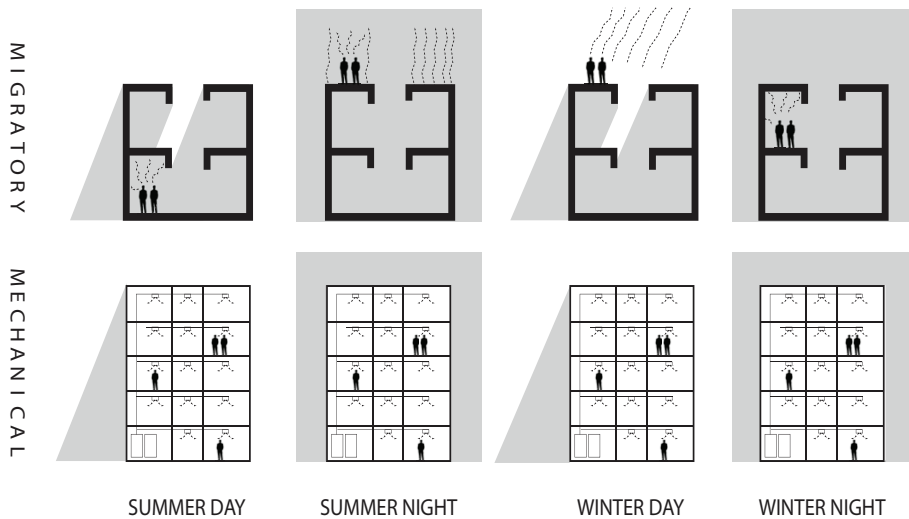
4

Fig. 05   Diagram showing vernacular vs. mechanized strategies for creating comfort within buildings

use initiated the changeover from a radiant to a convective system of heating… For the first time people began to understand a building as an enclosure for a bubble of warmed air and realized that attention had to be paid to making the building more airtight."[12] This however only addressed one side of the comfort equation.

The next revolutionary development was on the other end of the spectrum, cooling and dehumidifying. Willis Carrier is largely considered the father of air-conditioning for developing a way to both dehumidify and cool air. His definition "added to the control of humidity…the control of temperature by either heating or cooling, purification of the air by washing or filtering the air, and the control of air-motion and ventilation."[13] The air-conditioning technology was not developed with the intention of improving human comfort, but rather human productivity.

"Experiment and innovating installation… [of] ventilating and heating industries was oriented almost entirely towards improvements in factory environments, because there alone were the problems big enough, and profitable enough, to bring manufacturer of plans and its users together in situation where the economic advantage on both sides was clear enough."[14]

In fact, while air-conditioning technology was available in the early 1900s, it did not progress into a system that could be implemented in the domestic setting until almost half a century later. However, once the technology was developed, "window air-conditioners were rapidly finding their place in the American home and, by 1950; air-conditioning was the nation's second fastest growing industry."[15] The fast growth may have been due in part to the extensive use of advertising. An

emphasis was placed on control, mastery of the environment and the ability to achieve a perfect indoor climate with systems with names like 'Weather-maker.' Furthermore, "there was a strong theme of fashion on the air-conditioning advertisements, where middle-class women were well dressed, wearing fine jewelry and with gloved hands, suggesting an association between climate control and social status."[16]

The implementation of air conditioning systems spurred a shift in thinking, which can be seen with Carrier's first performance guarantee in 1907, "he faced the fact that what his clients were asking from him was to deliver reliably a certain kind of atmosphere, and offered to guarantee the quality of the environment."[17] Carrier specified what range of temperatures and humidity levels could be achieved and maintained with his system in the given circumstances. The widespread application of air-conditioning in commercial buildings led to the interest in standards, which served as a benchmark for what made people "comfortable," and as a side effect created "the (often exaggerated) need for air-conditioning as the only means to meet the standards."[18]

The development of environmental control technologies began an "alternative tradition." In particular, air-conditioning "has had enormous historical and cultural effects on people's attitudes about comfort, the way in which we design and inhabit buildings, and even ways in which we interact as a society."[19] Air-conditioning became part of the American standard of living by the 1960's and its use has been

found by several studies to fit the definition of addiction.[20] The use of this technology can alter the views of what temperatures are comfortable.

"It can eventually evolve into a physiological addiction where 'air-conditioning rapidly teaches the body to hate the heat,' and changes our perception and expectations of unconditioned spaces and the outdoors. We create artificial islands of cold within surroundings that are then characterized as 'hot' in contrast to those air-conditioned spaces."[21]

Conclusion

New technologies have not only changed our expectations and perceptions of comfortable climate conditions, they changed the relationship between building and comfort. These technological developments and their widespread use have shifted the responsibility for providing comfort from architects to engineers and a contextualized comfort into generic standards that fail to recognize the ability of design strategies to provide qualitatively different opportunities that address the broader aspects of comfort.[22] Where previous generations had to rely on form and material to create an acceptable level of comfort the modern expectation is that an engineer will provide a separate system that will create and maintain an ideal internal environment. "By providing almost total control of the atmospheric variables of temperature, humidity, and purity, it has demolished almost all the environmental constraints on design… For anyone who is prepared to foot the consequent bill for power consumed, it is now possible to live in almost any type or

form of house in any region of the world that takes the fancy."[23] As we enter into a new era with increased concern for energy expenditures we should explore the potential for reuniting building design and comfort design. The "appliance approach" to achieving comfort has led to the loss of thermal information as a component of design and place. Lisa Heschong notes, "We are unlikely to relate our thermal well-being to anything in particular unless there is an awareness at some level that an object or place does indeed have a thermal function… one factor that can help us to appreciate the thermal function of a place or object is variability."[24] Buildings that offer such an experience can help to broaden expectations from the current state of extreme consistency and control. In order to address the multiple facets of comfort we must move from the conventional practice to one that aims for interactive adaptability that allow the system to address changing needs over time.

Notes

1. Gail S. Brager, and Richard J. de Dear, "11. Historical and Cultural Influences on Comfort Expectations" *Buildings, Culture & Environment: Informing Local & Global Practices*, 2003, p. 177.

2. Ibid 178.

3. Ken C. Parsons "Introduction" from Nicol, Fergus et al (Eds.), Standards for Thermal Comfort: Indoor Air Temperature Standards for the 21st Century, 1995, p. xiii.

4. Benjamin Stein, et al, *Mechanical and Electrical Equipment for Buildings*, 10th Edition, 2006, pp. 86-103.

5. Richar J. DeDear, "Thermal Comfort in Practice" *Indoor Air*, Blackwell Munksgaard, 2004, p. 34.

6. Brager, 181.

7. Ibid, 180.

8. Ibid, 185.

9. Lisa Heschong, Thermal Delight in Architecture. London: The MIT Press, 1979. p. 8.

10. Reyner Banham. *The architecture of the well-tempered environment*. Chicago: The University of Chicago Press, 1969, p. 19.

11. Brager, 178.

12. Heschong, 14.

13. Banham, 82.

14. Ibid, 174.

15. Ibid, 178.

16. Brager, 180.

17. Ibid, 181.

18. Ibid, 186.

19. Ibid, 180.

20. Ibid, 183.

21. Ibid, 185.

22. Raymond J. Cole et al, "Re-contextualizing the notion of comfort," *Building Research and Information,* (2008), http://www.tandf.co.uk/journals, p.331.

23. Banham, 187.

24. Heschong, 36-37.

Figures

Cover: Raymond J. Cole et al, "Re-contextualizing the notion of comfort," *Building Research and Information,* (2008), http://www.tandf.co.uk/journals, p.331.

Figure 01: http://knol.google.com/k/william-pentland/solar-energy/1g0rrsoesmjko/2

Figure 02: http://www.johnharveyphoto.com/Japan4/Gunma/LoveThatKotatsuLg.jpg

Figure 03: http://upload.wikimedia.org/wikipedia/commons/c/c2/ClimateMapWorld.png

Figure 04: Behling, Sophia and Stefan, Solar Power: The Evolution of Sustainable

Architecture, 2000.

Figure 05: Jenna Kamholz illustration

References

Williamson, T.J., Coldicutt, S, and Riordan, P. "5. Comfort, Preferences, or Design Data?" from Nicol, Fergus et al (Eds.), Standards for Thermal Comfort, 1995.