

Research on Adaptive Design Thinking in the Craft Wisdom of Traditional East Asian Artifacts

Pei Liu

Fine Arts & Calligraphy College of Sichuan Normal University

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*Corresponding Author: Pei Liu

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Abstract

Original Research Article

This study examines climate-responsive craftsmanship in traditional East Asian artifacts, elucidating the adaptive design intelligence developed to accommodate regional climatic conditions. Adopting an environmental humanities perspective combined with empirical analysis, it reveals how artifacts regulate microclimates through form, material, and technique in response to hot-humid and cold climates. The core inquiry distills from the principle of “harmonizing with celestial timing and terrestrial qi, employing fine materials and exquisite craftsmanship” a synthesized wisdom integrating local knowledge, ecological principles, and aesthetic concepts. It aims to construct a theoretical framework of climate responsiveness, offering indigenous references for contemporary sustainable design and cultural heritage revitalization.

Keywords: Climate-Responsive Craftsmanship; Traditional East Asian Artifacts; Adaptive Design; Craft Wisdom; Environmental Humanities.

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1. Introduction

Against the backdrop of an escalating global climate crisis and the ascendance of sustainability as a core agenda, the design field urgently requires a fundamental paradigm shift beyond mere technological optimization. This shift not only calls for future-oriented innovation but also prompts a retrospective reexamination of localized wisdom in human-nature coexistence accumulated over the course of civilization. Traditional East Asian artifacts, as material bearers of daily life, embody in their forms, materials, and techniques a systematic adaptive design thinking that has long been overlooked. This thinking is not a precursor to modern ecological design theory but a practical philosophy rooted in specific regional climates and cultures, seeking harmonious coexistence with

dynamic environments through material practice. Excavating and articulating this adaptive foundation is critically significant for constructing contemporary design theory and practice that are both culturally substantive and ecologically effective. Current research on traditional craft wisdom largely focuses on aesthetic symbols, technical processes, or sociocultural significations. Even when environmental factors are addressed, they tend to be treated as static backdrops rather than active drivers of design. In architecture, while “climate responsiveness” has become an established paradigm, this perspective has yet to be adequately integrated into studies of the micro-scale of artifacts and systematic thought. Consequently, much of the wisdom embedded in traditional artifacts for addressing specific climatic challenges—such as heat and humidity, severe cold, and monsoons—has

been either reduced to empirical rules or romanticized as naive ecological sensibility. The rigorous design logic underlying these practices—how integrated innovations in form, material, technique, and usage respond to specific environmental pressures and crystallize into cultural identity—has yet to be thoroughly analyzed and theoretically constructed at the design-studies level.

This study therefore proposes and centers on the core concept of climate-responsive craftsmanship, defined as a traditional material practice system that develops under specific regional climatic conditions, employing integrated material, technical, and formal solutions to actively regulate microclimates, enhance functional and environmental suitability, and ultimately become embedded in local knowledge and value systems. Focusing on China, Japan, and Korea in East Asia, and selecting canonical traditional artifacts as analytical subjects, this study pursues the following objectives. First, transcending case-study particularism, it systematically reveals the specific mechanisms and patterns of climate response across three dimensions—morphological structure, material technique, and usage behavior. Second, on this basis, it distills the underlying unified adaptive design thinking, elucidating the profound implications of “harmonizing with celestial timing and terrestrial qi, employing fine materials and exquisite craftsmanship, and embodying the Way through artifacts.” Finally, it explores how this ancient wisdom can provide essential intellectual resources and translational pathways for contemporary climate-responsive design innovation and the living transmission of cultural heritage. This study not only aims to fill the theoretical gap in design history and material culture studies regarding the “climate-artifact” nexus, but also seeks to argue that the adaptive thinking embedded in traditional craft is a design philosophy concerned with cultivating relationships rather than fabricating objects. It reminds us that true sustainability may lie not in inventing new technological symbols, but in relearning—as our ancestors did—how to design, with profound insight and reverence, our modes of coexistence with the world.

2. Constructing an Analytical Framework of “Climate-Artifact-Wisdom”

2.1 Core Conceptual Definitions

Climate-responsive craftsmanship refers to a system of material practice that gradually develops and evolves under the long-term influence of specific regional climatic conditions. This system encompasses not only technical solutions addressing environmental pressures such as heat and humidity, aridity and cold, and monsoons, but also the local knowledge systems and ecological value orientations that guide these practices. Its core characteristics are systematicity, proactivity, and cultural embeddedness.

Adaptive design thinking is the core philosophy and methodology distilled from the practice of climate-responsive craftsmanship. It is a mode of thought and operational principle that aims at dynamic equilibrium, actively mediating the human-nature relationship through material practice. Its connotations extend beyond mere functional adaptation, emphasizing compliance with and utilization of natural rhythms in the temporal dimension, accommodation and modification of site-specific microclimates in the spatial dimension, and minimization of resource intervention and cyclical use in the ethical dimension.

Craft wisdom denotes the cognitive achievements distilled from the above thought and practice, transcending specific historical periods. It unifies “knowing how” with “knowing why,” manifesting as a practical wisdom embodied in material forms concerning sustainable ways of being-in-the-world.

2.2 Literature Review and Theoretical Gaps

Existing research provides essential foundations while simultaneously revealing the urgency of theoretical integration. Material culture studies have extensively elucidated the social lives and symbolic meanings of artifacts, yet tend to treat environment as static background, rarely scrutinizing the mechanisms through which climate shapes artifacts’ material properties. Technical history and craft studies have meticulously documented materials and

techniques, largely emphasizing lineages and aesthetic achievements, but insufficiently distilling the universal ecological design principles embedded within. The burgeoning field of sustainable design theory and ecological design critique offers forward-looking value frameworks, yet its discourse, grounded in modern industrial contexts, remains discursively distanced from localized, pre-industrial traditional wisdom. A critical theoretical gap thus persists: how to construct an analyzable, explicable bridge between concrete artifacts and abstract thought, between local experience and universal principles. This demands interdisciplinary dialogue and integration.

2.3 Analytical Framework: A Three-Tier Model of “Climate-Artifact-

Wisdom”

Based on the above concepts and theoretical background, this study proposes a three-tiered, dynamically relational analytical framework to systematically reveal the transformative process from climatic challenge to cultural wisdom (Fig. 1).

2.3.1 Climate Driver Tier

This is the starting level of analysis. Drawing on historical climatology and environmental history, climate is understood not merely as temperature and humidity data, but as a composite environmental stress field encompassing thermal, hygric, aerodynamic, and luminous physical factors, interacting with geography, vegetation, and hydrology. Analysis at this tier aims to identify the predominant climatic challenges of specific regions and the concrete problems they pose for human

habitation and artifact preservation.

2.3.2 Artifact Response Tier

This is the core empirical dimension of the framework. Artifacts, as mediators of human-environment relations, exhibit integrative responsiveness. Analysis proceeds along three interrelated pathways. First, morphological and structural response: examining how artifact form, spatial layout, and component relationships embody thermodynamic and aerodynamic principles. Second, material and technical response: investigating the cognition, selection, and modification of local material properties, and the distinctive techniques thus developed. Third, usage and behavioral response: examining how artifact design prescribes or embeds specific seasonal usage patterns, maintenance practices, and spatial arrangement logic, forming a dynamic behavioral adaptation system.

2.3.3 Cultural Integration Tier

This is the key level of wisdom distillation. When effective technical solutions achieve stability, transmission, and cultural significance, they ascend to wisdom. Analysis at this tier focuses on: how dispersed experience is codified into local knowledge, technical mnemonic rhymes, or professional norms; how adaptive practices integrate with cultural values such as “cherishing materials,” “conforming to heaven,” and “achieving equilibrium,” generating ethical constraints on making; and how forms shaped by adaptation come to be recognized as purposeful beauty—the transformation of ecological rationality into aesthetic legitimacy.

Subtropical maritime monsoon climate (Cfa/Cwa): high temperature and humidity, distinct seasons, frequent typhoons. Representative regions: Okinawa in Japan, Taiwan in China, Jeju Island in Korea.

2.4.3 Case Coding Framework

Each artifact is coded and analyzed along three dimensions (Table 1):

Table 1 Coding Analysis Framework

Coding Dimension	Sub-items	Description	Coding Dimension
Morphology and Structure	Formal characteristics, scale and proportion, component relationships	Analysis of how artifact form responds to thermodynamic and aerodynamic principles	Morphology and Structure
Materials and Techniques	Material types, processing techniques, material sources	Investigation of the cognition and modification of local material properties	Materials and Techniques
Use and Behavior	Modes of use, seasonal operations, maintenance mechanisms	Examination of how artifacts are embedded in daily practice	Use and Behavior

Source: Author's own work

3. Climate Response Dimensions and Mechanisms of East Asian Artifacts

First, from the morphological and structural dimension (Table 2), the physical form of artifacts directly reflects an intuitive understanding and application of thermodynamic and aerodynamic principles. In humid subtropical zones (Cfa), the core function of artifacts is to promote heat dissipation and ventilation. Taking the Japanese iron kyūsu (teapot) from southern Japan as an example, its body is ornamented with raised arare (hailstone) patterns—this formal design increases surface area to accelerate heat dissipation, while the textured surface facilitates grip and prevents burns, representing a typical case of form serving thermal

comfort. In continental monsoon zones (Dwa), artifacts emphasize heat retention and storage. The thick-walled pottery jars of northwestern China and the jangdok (fermentation crocks) of the Korean Peninsula (Fig. 2), with their rounded, full-bodied forms, minimize the surface-area-to-volume ratio, while the short, narrow necks effectively suppress internal convective heat loss, creating stable microclimatic storage spaces. Notably, artifacts within the same climate zone may exhibit differentiated response strategies: for instance, the low, flat tables used with Korean ondol heating systems embody adaptability not in the artifact's own insulation structure but in its coordination with the building's heating system.

Table 2 Coding Table for Climate Response Case Analysis of Traditional East Asian Artifacts

Artifact Case	Climate Zone	Core Climate Challenge	Response Dimension (Form/Material/Use)	Design Thinking
Ryukyu clay pot (Okinawa)	Subtropical maritime monsoon (hot-humid)	High temperature and humidity, food spoilage	Form: porous clay body, increased evaporative surface area; Material: high-permeability clay; Use: evaporative cooling through water storage	Evaporative cooling principle for passive microclimate regulation
Low table for Korean ondol	Continental monsoon (cold winter)	Cold floor, discomfort from prolonged sitting	Form: low and flat, integrated with ondol heat source; Material: insulating solid wood; Use: coordinated with floor heating system	Integrated design of furniture with building heating system
Thick-walled pottery jar (NW China)	Continental monsoon (dry-cold)	Severe winter cold, large diurnal temperature range, high heat retention demand	Form: rounded fullness minimizing surface/volume ratio; short neck suppressing convective heat loss	Maximized thermal retention using thermal inertia for internal temperature stability
Korean jangdok (fermentation crock)	Continental monsoon (cold winter, hot summer)	Large annual temperature range, need for stable fermentation temperature	Form: wide-mouthed, swollen belly, semi-buried design; Material: moderately permeable clay facilitating microbial exchange	Passive temperature and humidity control utilizing ground temperature stability
Low table for Korean ondol	Continental monsoon (cold winter)	Cold floor, discomfort from prolonged sitting	Form: low and flat, integrated with ondol heat source; Material: insulating solid wood; Use: coordinated with floor heating system	Integrated design of furniture with building heating system
Huizhou fire bucket (China)	Humid subtropical (damp-cold winter)	Damp-cold indoor conditions without central heating	Form: bamboo-woven casing enclosing ceramic bowl, lightweight and portable; Material: bamboo for insulation and burn protection, ceramic for heat storage	Portable personalized micro-warm zone, liberating heating from fixed spaces
Chinese lacquerware	Humid subtropical (damp, rainy)	Dampness causing decay and mildew in wood/bamboo products	Form: multi-layered composite of fabric, putty, and lacquer; Material: raw lacquer forming dense inert protective film for waterproofing	Natural polymer material solution for dampness, passive protection through material modification

Japanese iron kyūsu (teapot)	Humid subtropical (hot-humid)	Heat discomfort during tea drinking, high heat dissipation demand	Form: arare patterns increasing surface area for accelerated heat dissipation; textured surface for grip; Material: cast iron for even heat conduction; hollow handle for insulation	Form serving thermal comfort and safety through passive heat dissipation via increased surface area
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Source: Author's own work



Fig. 2 Thick-walled Pottery Jars from Northwest China and Fermentation Crocks from the Korean Peninsula

Source: Gansu Provincial Museum

Second, at the material and technical level, in-depth knowledge and innovative modification of local material properties constitute the fundamental pathway to climate adaptation. Material selection and processing techniques directly address challenges of humidity, temperature, and biological degradation. In the humid, rainy East Asian monsoon region, the widespread use of lacquerware is no coincidence. By repeatedly applying fabric, putty, and raw lacquer to wood or bamboo cores, lacquerware forms a dense, hard, non-toxic inert protective film highly resistant to moisture and corrosion, perfectly resolving the susceptibility of wood and bamboo products to decay and mildew in hot-humid environments. Similarly, the elevated clay jars used for fish sauce fermentation in Southeast Asia employ specially formulated clay with good permeability, enabling gas release during fermentation while effectively regulating the microenvironment for internal microbial communities. For severe cold climates, innovations

such as the oiled paper used in Korean ondol houses—paper repeatedly impregnated with tung oil to become tough, waterproof, and translucent with insulating properties—exemplify material innovation coordinated with heating systems.

Finally, at the use and behavioral level, artifact design guides and integrates into a dynamic behavioral repertoire synchronized with climatic rhythms, rendering adaptation a matter of daily practice. The “adaptiveness” of many artifacts is not entirely statically embedded in the object itself, but is ultimately realized through human use. The fire bucket (Fig. 3) used in winter in China’s Huizhou region, with its bamboo-woven casing enclosing a ceramic bowl for charcoal, encourages specific usage: placed underfoot or held, and covered with clothing to create a personalized portable micro-warm zone. This behavioral response liberates heating from fixed architectural spaces, flexibly addressing locally cold indoor environments in winter. Likewise, the detachable wooden doors and

windows found throughout China, Japan, and Korea are designed with seasonal behavior in mind—fully removed in summer for open ventilation, and fitted with paper in winter for insulation and light

transmission, with artifacts integrated into the building envelope and their functions shifting with the climatic cycle.



Fig. 3 Fire Bucket Used in winter in Huizhou, China

Source: Toutiao

4. From Adaptive Technology to Design Philosophy

The preceding empirical analysis demonstrates that traditional East Asian artifacts exhibit sophisticated and systematic technological integration in addressing climatic challenges. Yet to stop at this level would be to complete only part of the work. These discrete, material-level techniques can only be truly understood as a complete design philosophy when situated within the cultural cognition and value systems from which they emerged and evolved. This section aims to achieve this critical theoretical ascent, distilling from concrete adaptive technologies three core design principles of universal heuristic value.

The primary design principle manifests as a systematic spatiotemporal view of “heavenly timing

and terrestrial qi,” which positions material practice as a dynamic process embedded within natural rhythms and geographical contexts. “Heavenly timing” signifies absolute respect for temporality. The making, use, and maintenance of artifacts follow strict temporal schedules, as cautioned in *the Kaogongji*: “Fine materials and exquisite craftsmanship, yet if not timed properly, they will fail.”¹ Spring felling, autumn lacquer collection, and winter pottery-making are not superstitions but profound understandings of causal relationships between material properties, temperature-humidity conditions, and technical outcomes. “Terrestrial qi” emphasizes absolute local adaptation. Artifact forms and materials are not arbitrarily chosen but are direct responses to local environmental stresses. The regional variation in clay formulations, for instance,

¹ Wen Renjun. *The Kaogongji: An Annotated Translation* [M].

Shanghai: Shanghai Chinese Classics Publishing House, 2021.

represents artisans' active adjustments to suit local firing climates and usage environments—a form of geographical customization. This spatiotemporal view constructs an ecological ethic of compliance first and guidance second, transforming design from isolated object creation into a coordinative art of cultivating harmonious relations within spatiotemporal coordinates.

Second, it manifests as a dialectical technical ethic of “fine materials and exquisite craftsmanship,” achieving a delicate balance between respecting the essential properties of materials and exercising human creativity. “Fine materials” does not refer to innate perfection but to the artisan's deep understanding of and respect for their inherent potentials and limitations. Material practice begins with inquiring into materials—investigating the flexural limits of specific bamboos, the shrinkage characteristics of specific clays, and their long-term performance under local climatic conditions. “Exquisite craftsmanship” is the active guidance and facilitation based on this understanding, rather than conquest or distortion. In lacquer craftsmanship, for example, artisans must accommodate the high-humidity conditions required for lacquer drying, developing the specialized yin fang (humidity chamber) as a workspace. Making thin-bodied porcelain requires understanding the stress changes of clay during drying and firing, employing refined trimming and firing control to prevent warping or cracking. Here, beauty (fine materials) and goodness (exquisite craftsmanship) are unified in the artifact's purposefulness and durability under specific environmental conditions, with aesthetic judgment intrinsically encompassing functional rationality and environmental adaptability.

Ultimately, it ascends to a practical wisdom ontology of “the Way is realized through use,” establishing the artifact as a core medium mediating human-nature and individual-society relations. This thinking transcends the pragmatic category of tools, pointing toward a path of practicing and comprehending worldly truth through making and using. “Use” is both the realization of artifact function in specific climatic contexts—such as water storage in clay jars for freshness preservation—and the sustained

dialogue and bodily memory constructed between humans, artifacts, and environment through use. Artifacts thus become carriers storing and transmitting local knowledge, ecological cognition, and even cosmological concepts. A family-heirloom kimchi pot, for instance, with its form, glaze, and usage methods, embodies a complete knowledge system concerning local microbial environments, seasonal ingredients, and dietary health. This wisdom is embodied—residing in the artisan's hand-feel, the user's habits, and community customs—and cannot be fully transmitted through text alone. This suggests that the most profound design thinking is not abstract theoretical dogma but living knowledge precipitated in daily practice, addressing concrete problems of survival.

5. The Transformative Value of Traditional Wisdom

The distillation of climate-responsive craftsmanship in East Asia is not merely historical retrieval; its core value lies in offering a profound paradigmatic reference and translational resource for contemporary design confronting ecological crisis and cultural homogenization. The design philosophy embedded in traditional wisdom can effectively compensate for the limitations of current mainstream sustainable design, which over-relies on technological solutions while lacking cultural depth. The primary implication is a recalibration of universality and locality. Modern design often pursues universally applicable solutions, whereas traditional wisdom demonstrates that genuine sustainability is deeply contingent on nuanced understanding of specific regional climates, materials, and ways of life. This suggests a shift from pursuing globalized standard solutions toward encouraging localized knowledge innovation grounded in regional microclimates and cultures, fostering more adaptive and diversified approaches. Second, it entails a paradigm shift from object-oriented to relation-oriented thinking. Traditional material practice consistently situates artifacts within the dynamic nexus of “human-artifact-environment,” with beauty and value deriving from relational harmony. This offers fundamental insight for

contemporary design to transcend narrow formal and functional categories, extending toward designing behavioral patterns, service systems, and even novel human-environment interactions. Creative transformation may follow these pathways: at the principle level, extracting thermodynamic and material principles for application in new materials or structural development; at the paradigm level, drawing on the process from compliance to guidance to construct design methodologies based on regional environmental data; at the philosophical level, integrating ethical concepts such as “heavenly timing and terrestrial qi” and “cherishing materials and coexistence” into design education to cultivate systemic thinking and ecological responsibility. Ultimately, this transformation aims not merely to produce green products, but to cultivate a lifestyle and civilizational attitude of reconciliation with nature and greater cultural stability.

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Author Biography

Liu Pei, Ph.D. in Educational and Technological Philosophy; faculty member in the Department of Calligraphy, School of Fine Arts and Calligraphy, Sichuan Normal University. Research focuses on calligraphy education and digital aesthetic education. Serves as Council Member of the Basic Calligraphy Education Branch of the National Education Association for Calligraphy and Painting, Deputy Secretary-General of the Calligraphy Education Professional Committee of the Sichuan Education Association, Standing Council Member of the Fine Arts Education Professional Committee of the Sichuan Education Association, Council Member of the Film and Television Education Professional Committee of the Sichuan Education Association, expert panelist of the Sichuan Education Evaluation Institute, and Secretary-General of the Chengdu Young Calligraphers Association. Leads key research projects including “Techniques Refinement in Three-Script Writing and Enhancement of Teaching Practice Competence for Normal Students”

under the Sichuan Higher Education Association for Calligraphy Education, and “AI-Empowered Integration of Calligraphy and Shu Embroidery from an Interdisciplinary Perspective” under the Key Chinese Culture Research Institute (Traditional Crafts Research Institute) of the Sichuan Federation of Social Sciences; serves as principal investigator for special tasks including “Activity Models of Art Education Workshops in Primary and Secondary Schools” under the Ministry of Education’s Department of Sports, Health and Arts Education, and major projects including “Implementation Strategies for Aesthetic Education Infiltration in Primary, Secondary, and Tertiary Institutions” under the Sichuan Education Science Planning; and participates in high-level think tank projects of the Ministry of Education. Has published 25 English articles in international journals including IJSSH, ELTLS, and IJEMH, and 40 Chinese articles in national and provincial journals such as Traditional Craft Studies, Studies on Chinese Literati Painting,

Popular Calligraphy, Calligraphy Appreciation, Calligraphy Education, and Calligraphy News. Serves as peer reviewer for the international journal Higher Education Research. Author of the Chinese monograph Technology and Aesthetic Education: A Practical Analysis of Virtual Reality in Art Appreciation (Guangming Daily Publishing House); Chinese monograph Observing the World through Three Realms: The Spatiotemporal Symphony of Brush, Ink, and Silver Salt (Sichuan Fine Arts Publishing House); English monograph Research and Practice of Chinese Excellent Traditional Culture Education (Generis Publishing, Switzerland); co-author of the Chinese monograph Implementation Strategies for Aesthetic Education Infiltration in Primary, Secondary, and Tertiary Institutions (Guangming Daily Publishing House); co-author of Artist’s Sketchbooks: Van Gogh (People’s Posts and Telecommunications Publishing House). (Tel) 18080046797; (Email) 592947743@qq.com.