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АРХИТЕКТУРА КАК СОВОКУПНОСТЬ РЕАКЦИЙ ЧЕЛОВЕКА НА ВЫЗОВЫ ОКРУЖАЮЩЕЙ СРЕДЫ

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Аннотация. Архитектура представляет собой совокупный ответ человеческого общества на экологические вызовы, служащий связующим звеном между историческими традициями и инновациями для создания устойчивой среды современных городов. В данной статье рассматривается роль биоклиматических и энергоэффективных архитектурных методов, используемых для смягчения последствий изменения климата, содействия созданию комфортной городской среды. На основе анализа исторических прецедентов и современных примеров исследование демонстрирует, как принципы устойчивого проектирования могут уменьшить деградацию окружающей среды, поддерживая сбалансированное и устойчивое городское развитие.

Ключевые слова: устойчивая архитектура, энергоэффективная архитектура, биоклиматические методы в архитектуре, городская регенерация, городская среда

Original article

ARCHITECTURE IS THE SUM TOTAL OF MAN'S RESPONSES TO THE CHALLENGES OF THE ENVIRONMENT

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Abstract. Architecture represents the cumulative response of human societies to environmental challenges, serving as a bridge between historical traditions and contemporary innovations to foster a sustainable built environment. This paper examines the role of bioclimatic and energy-efficient architectural practices in mitigating climate change, promoting urban regeneration, and enhancing social cohesion. Through an analysis of historical precedents and modern case studies, the study demonstrates how sustainable design principles can reduce environmental degradation while supporting equitable and resilient urban development.

Keywords: sustainable architecture, energy-efficient architecture, bioclimatic methods in architecture, urban regeneration, urban environment

Architecture embodies humanity's adaptive dialogue with the environment, merging historical wisdom with innovation to cultivate sustainable, resilient habitats. This paper posits that bioclimatic and energy-efficient design principles are pivotal in addressing climate change, revitalizing urban spaces, and fostering social equity. Through a synthesis of ancient practices and

modern case studies, it argues that sustainable architecture can mitigate ecological degradation while enhancing communal well-being, offering a blueprint for equitable urban futures.

The interplay between human needs and environmental constraints has shaped architectural evolution. As urbanization accelerates and climatic shifts intensify, the discipline must leverage scientific rigor and historical insights to navigate contemporary challenges. This exploration bridges architectural heritage, bioclimatic strategies, and urban dynamics, advocating for a holistic framework that aligns technological advancement with ecological and social imperatives.

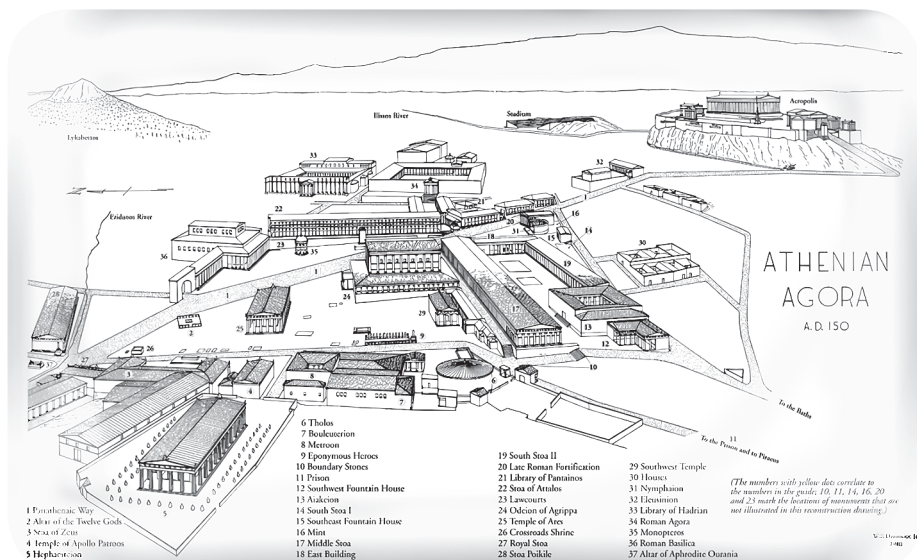
Historical precedents reveal enduring solutions to environmental adaptation. Aristotle's vision of the polis underscored urban planning's role in societal harmony, exemplified by Panathinaion Street in ancient Athens — a verdant axis optimizing natural ventilation and sunlight, principles still relevant for combating urban heat islands. Similarly, the Bronze Age settlement of Akrotiri in Santorini pioneered passive cooling and daylighting systems, its design ethos echoing in modern EU architectural competitions. These examples highlight the timelessness of climate-responsive design. Beyond the Mediterranean, traditional Japanese

1. Ancient Panathineon street: It is today the central green axis of the city of Athens and ensures the ventilation and the solarization of the dense urban tissue around it

2. Akrotiri Interior — Bronze age city bioclimatic enhancement and regeneration — EU Solar House Award. Author's photo

3. Akrotiri Exterior — Bronze age city bioclimatic enhancement and regeneration — EU SOLAR HOUSE AWARD. Author's photo

4. Bioclimatic Architecture in West Indies University at Trinidad — EU AWARD. Author's photo



(The numbers with yellow dots correlate to the numbers in the guide; 10, 11, 14, 16, 20 and 21 mark the locations of monuments that are not illustrated in this reconstruction drawing.)

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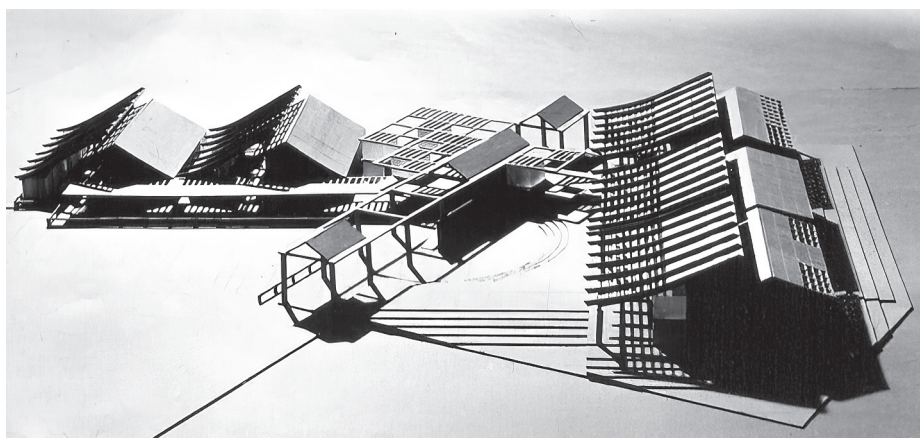
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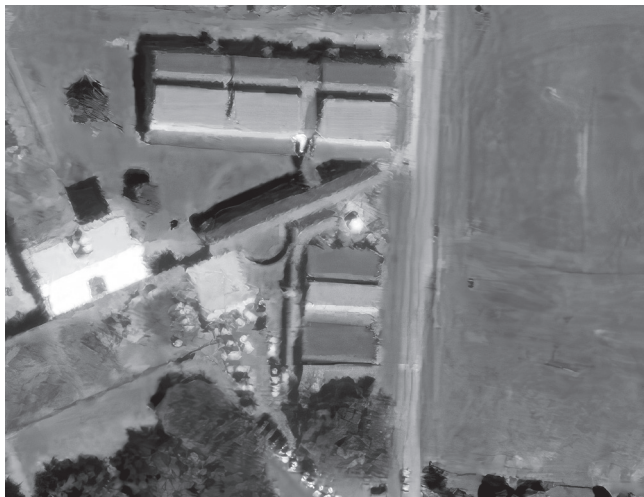
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5. Bioclimatic Architecture in West Indies University at Trinidad — EU AWARD. Author's photo

6. Bioclimatic Architecture in West Indies University at Trinidad — EU AWARD. Author's photo

7. Faliron bay, Athens, an extended bioclimatic area. Author's photo

8. Faliron bay, Athens, an extended Urban Bioclimatic area through Solar and Wind streets

“machiya” townhouses integrated adjustable lattices and earthen walls to modulate humidity and temperature, while Middle Eastern windcatchers harnessed airflow for natural ventilation, demonstrating a global legacy of bioclimatic ingenuity. Such vernacular architectures, often overlooked in Western-centric narratives, provide critical insights into region-specific sustainability strategies.

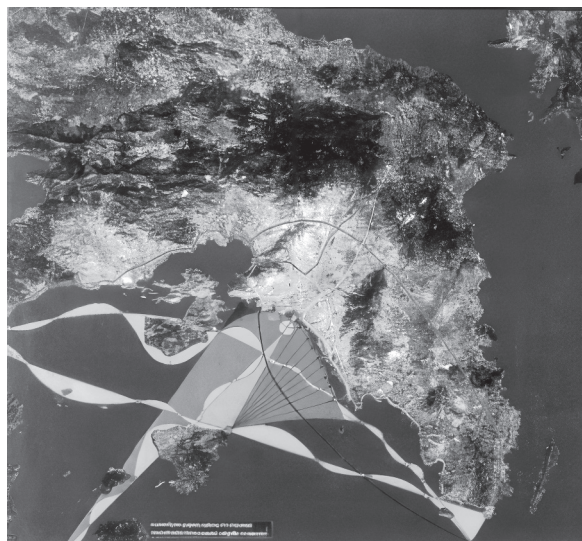


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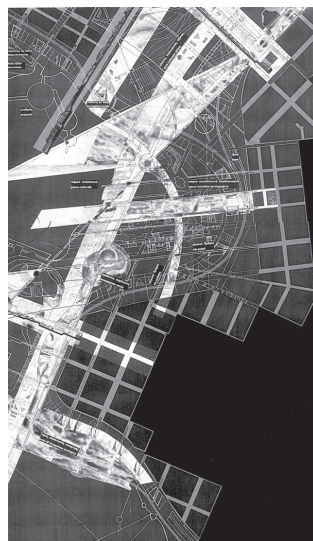
Philosophical underpinnings further illuminate architecture's societal role. Plato's "Republic" linked urban form to social justice, a stark contrast to modern cities plagued by unchecked development, responsible for 38% of global pollution. Legislative alignment with sustainable practices is critical to curbing emissions from construction and transportation, ensuring cities evolve as equitable spaces. The Renaissance architect (Vitruvian) Vitruvius and his principles, advocating for harmony between human proportions and natural order — a precursor to modern ergonomic and ecological design. In the 20th century, Jane Jacobs' critique of modernist urban planning emphasized the socio-environmental value of mixed-use neighborhoods, resonating with today's push for Polycentric cities that reduce carbon footprints through localized living.

Renewable energy integration emerges as a cornerstone of contemporary urban design. Solar-activated streets and wind corridors, tested in Athens and Beijing urban tissues demonstrate reduced reliance on fossil fuels. Adaptive systems inspired by the Archigram movement and naval architecture, such as Faliron Bay's redevelopment, merge mobility with renewable infrastructure, illustrating dynamic responses to environmental flux. The Dutch "Energy Sprong" initiative, retrofitting post-war housing with net-zero energy systems, exemplifies scalable solutions for existing urban fabrics, blending retrofitting with aesthetic renewal.

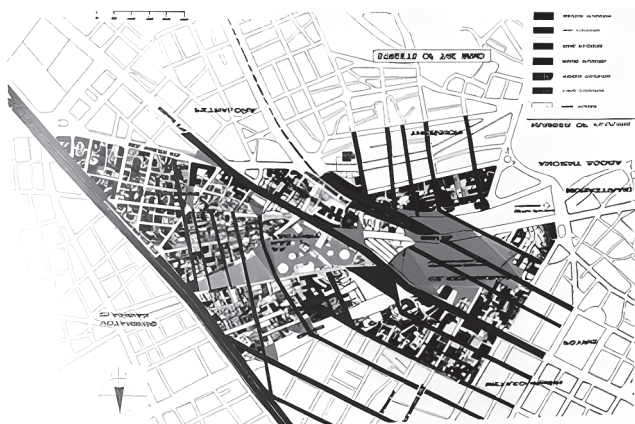
The temporal dimension of architecture — bridging past and present — is vital for cultural continuity. Athens' unification of archaeological sites into an open-air museum preserves heritage while enriching urban life, a model for sustainable tourism. Digital tools like LiDAR scanning and 3D reconstruction



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9. Green unification of Athens
Archaeological sites – Kerameikos
Urban bioclimatic renovation.
Creation of wind streets in the
surrounding urban tissue

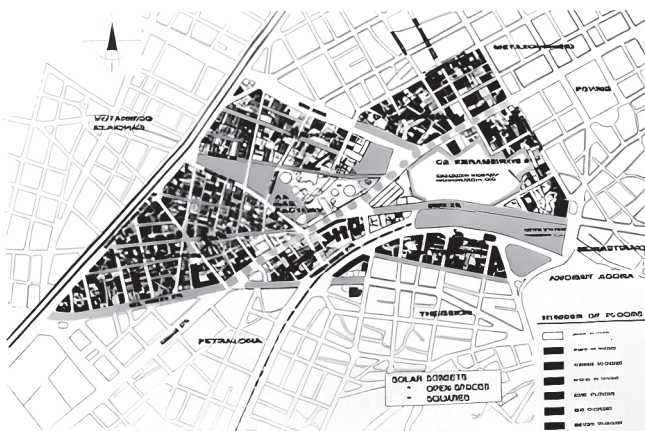
10. Creation of Solar Streets in
the surrounding urban tissue of
Kerameikos Archaeological Area

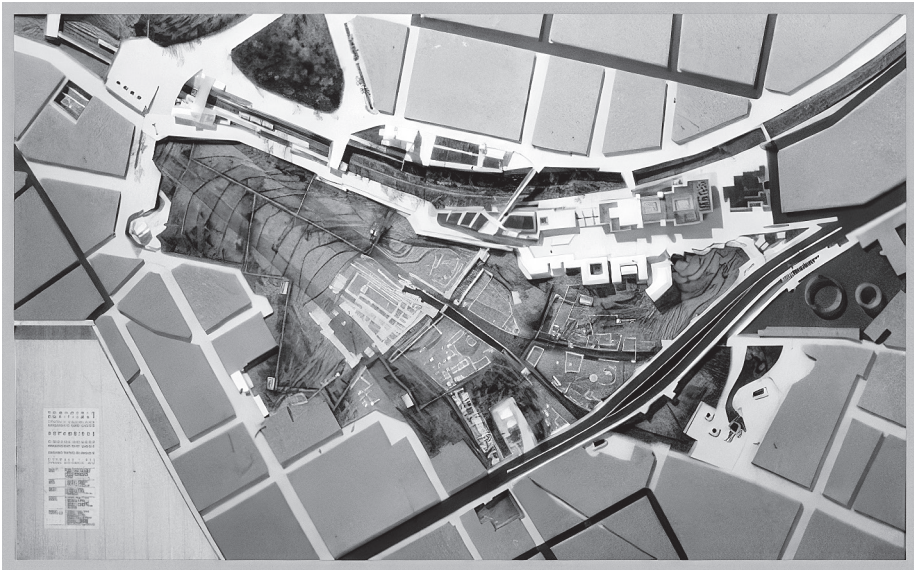
11. Green unification of Athens
Archaeological sites – Kerameikos
Archaeological Area. Urban
bioclimatic renovation

12. Unification of Athens
Archaeological Sites: A large "open"
museum has been created, unifying
the rich cultural heritage with the city's
everyday life

now enable precise preservation of historical sites while integrating them into modern infrastructure, as demonstrated in Petra's sensor-based conservation projects. Technological lineage, from the Antikythera Mechanism to parametric design tools, reflects humanity's enduring quest to harmonize innovation with ecological needs. The revival of ancient Roman concrete recipes, which utilized volcanic ash for self-healing properties, inspires modern carbon-sequestering materials, illustrating how historical techniques can inform cutting-edge sustainability.

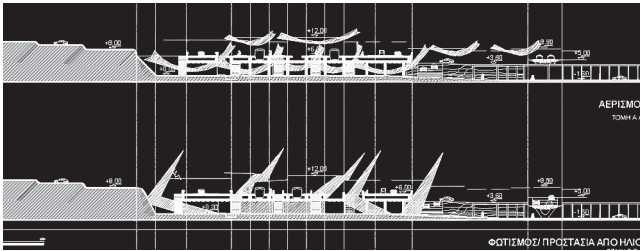
Modern cities grapple with thermal inefficiency, poor ventilation, and resource misuse. Case studies from Athens Olympic Metro Station and Kerameikos Urban renovation, Tirana's revitalization, Beijing's Olympic Solar Grid, and Masdar City's





carbon-neutral blueprint showcase bioclimatic interventions' potential. These projects exemplify passive cooling, renewable integration, and community-centric planning, addressing urban deficiencies through ecological design. Post-pandemic urbanism further underscores the need for adaptive public





13. Sustainable by Design Strategy optimizes efficiency through design, Renewable Energies. The 2004 Athens Olympic Metro Station. High performance and environmentally design technologies are integrated to the greatest extent in the project conception

14. The 2004 Athens Olympic Metro Station. High performance and environmentally design technologies are integrated to the greatest extent in the project conception. Author's photo

15. Green unification of Archaeological sites – Kerameikos Urban renovation

16. Solar and Wind streets in Beijing Forbidden City

spaces; Barcelona's "superblocks" prioritize pedestrian zones and green corridors, reducing air pollution while fostering social interaction. Meanwhile, Medellín's green corridors, built along former crime-ridden waterways, merge ecological restoration with social equity, proving that sustainable design can heal both ecosystems and communities.

As technology reshapes practice — parametric modeling, AI-driven simulations — the architect's





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role faces redefinition. While automation enhances efficiency, human-centric and ecological priorities must remain paramount. The profession must balance technocentric tools with empathy, ensuring designs prioritize livability and environmental stewardship. AI's potential to optimize material use and energy flows, as seen in the MIT-mediated design of Singapore's Treepod

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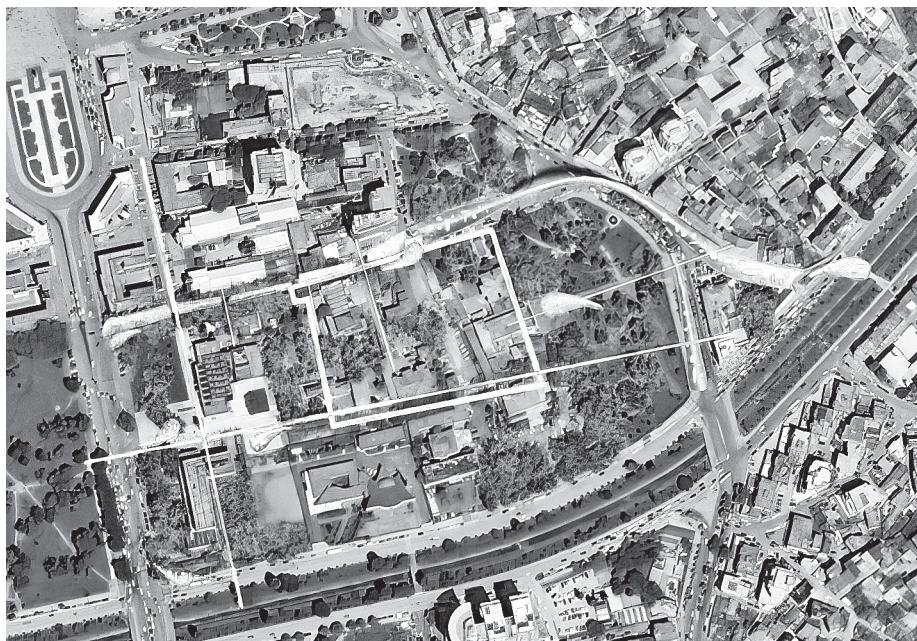
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residences, coexists with risks of homogenizing cultural specificity. Virtual reality platforms now engage citizens in participatory planning, democratizing design processes — a shift evident in Helsinki’s “City Scope” initiative, where residents co-create climate-resilient neighborhoods through immersive digital interfaces.

Equity is central to sustainable futures. Vulnerable populations, as Kofi Annan noted, disproportionately bear climate impacts. Prioritizing bioclimatic solutions for marginalized communities, adopting global solar frameworks starting from the Athens Charta (1933) towards the Berlin 1996 Solar Charta, and crafting equitable policies rooted in historical precedents are imperative. The vision of a “META-POLIS” demands urban landscapes where justice and sustainability coexist. Rwanda’s Green City Kigali, designed with affordable passive housing and agro-urban hubs, empowers low-income residents through energy sovereignty. Conversely, Detroit’s urban farms, repurposing vacant lots into community-led green infrastructure, highlight grassroots resilience in post-industrial contexts.



In conclusion, architecture must reclaim its agency as a catalyst for resilience. By interweaving ancestral knowledge with cutting-edge innovation, the discipline can steer urban development toward adaptability, equity, and ecological balance. Future research should expand bioclimatic applications across diverse climates and socioeconomic contexts, ensuring architecture remains humanity's responsive dialogue with an ever-changing world. Emerging frontiers — such as biofabricated materials, circular construction economies, and AI-augmented participatory design — demand interdisciplinary collaboration, uniting scientists, policymakers, and communities to reimagine cities as living systems. Only through this synthesis can architecture transcend its role as shelter, becoming a dynamic force for planetary healing and collective flourishing. It is time now for adding a 18th UN sustainable development goal (SDG) based on bioclimatic architecture principles.

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