

Supplementary Materials

ENVIRONMENTAL ADAPTATION IN ISLAMIC ARCHITECTURE: EVALUATING THE SAHEB-OL-AMR MOSQUE IN THE URBAN CONTEXT OF TABRIZ

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1. RESULT AND DISCUSSION

1.1. GEOGRAPHICAL AND HISTORICAL OVERVIEW OF THE SAHEB-OL-AMR MOSQUE

The Saheb-Ol-Amr Mosque of Tabriz demonstrates a rich historical layering that reflects both the Qajar period and later renovations from the Pahlavi and contemporary eras. Located in the central urban area of Tabriz, the mosque is positioned at an elevation of 1351 meters, within a mixed historic-commercial fabric. The total land area of 4200 m² and the infrastructure area of 3150 m² indicate a compact yet multifunctional religious complex. Its geographic location and orientation along Saheb-Ol-Amr Street provide accessibility while maintaining harmony with the surrounding traditional texture. The mosque's urban setting plays a crucial role in regulating microclimatic conditions such as wind flow and solar exposure. As a landmark structure, its spatial organization integrates social, cultural, and spiritual functions, enhancing the identity of the central district. The combination of traditional materials and spatial hierarchy ensures both environmental adaptability and architectural continuity. This table 1 highlights the importance of geographical context in shaping the mosque's design philosophy, emphasizing how local conditions and cultural heritage have guided its evolution through centuries.

Table 1. General characteristics of the Saheb-Ol-Amr Mosque of Tabriz and its geographical location.

Specifications	Size/Description
Full name of the building	Saheb-Ol-Amr Mosque (AJ)
Location	Tabriz, Saheb-Ol-Amr Street, Central City Area
Geographic coordinates	38°04'N, 46°18'E
Elevation above sea level	1351 m
Construction period	Qajar period with Pahlavi and contemporary renovations
Total land area	4200 m ²
Infrastructure area	3150 m ²
Surrounding texture type	Historic-intermediate area with predominantly residential-commercial use

1.2. CLIMATIC PARAMETERS OF TABRIZ AND THEIR INFLUENCE ON ARCHITECTURAL DESIGN

The climate of Tabriz—classified as cold and dry—has profoundly influenced the design and construction techniques used in Saheb-Ol-Amr Mosque. The significant temperature fluctuations between summer (up to 40°C) and winter (down to -25°C) necessitated thick walls, deep spaces, and limited openings to provide insulation and thermal stability. The annual rainfall (280–320 mm) and moderate humidity (55–65%) shaped strategies for minimal water usage and effective ventilation. Orientation toward the North-Northwest helps in shielding from prevailing cold winds, while long sunshine hours (up to 3000 hours annually) encouraged the use of natural lighting and passive heating techniques. The table 2 illustrates how environmental parameters directly determined spatial organization, material selection, and building form. Each climatic factor—from wind to solar radiation—was translated into architectural responses such as shading, natural ventilation, and heat storage. This balance between environmental constraints and architectural innovation exemplifies the wisdom of traditional builders in creating sustainable, climate-responsive religious architecture.

Table 2. Tabriz Climatic Parameters and Impact on Design.

Climatic factor	Amount	Design requirements
Climate type	Cold - Dry	Requirement for high thermal insulation
Annual average temperature	12.5°C	Seasonal temperature control
Summer maximum temperature	35-40°C	Requirement for shading and ventilation
Winter minimum temperature	-15 to -25°C	Thick walls, ground spaces
Annual rainfall	280-320 mm	Limited rainwater managementrenovations
Prevailing wind direction	North-Northwest	Building orientation and windbreak protection
Average relative humidity	55-65%	Balanced ventilation
Annual sunshine hours	2800-3000 hours	Utilization of natural light

1.3. ARCHITECTURAL ELEMENTS AND STRUCTURAL ADAPTATION TO COLD CLIMATE

The physical organization of the Saheb-Ol-Amr Mosque reflects deep climatic sensitivity, optimizing comfort through material and spatial design. The thick load-bearing brick walls (up to 120 cm) ensure heat storage and gradual release, stabilizing internal temperatures during harsh winters. The double-layer dome creates an insulating air cavity that aids in ventilation and natural light reflection, while vaulted ceilings reduce heat exchange and enhance structural resilience. Transitional spaces such as vestibules and porches act as thermal buffers, minimizing direct exposure to cold winds. The distinction between winter and summer shabestans demonstrates functional adaptability, with the former located underground for warmth retention and the latter connected to open courtyards for ventilation. The courtyard itself serves as a microclimate regulator, absorbing solar energy and moderating airflow. This table 3 highlights the mosque's intricate integration of form and function, where every element-from wall thickness to courtyard geometry-responds to the regional climate. Such architectural wisdom ensures energy efficiency and user comfort without mechanical dependence.

Table 3. Physical structure compatible with the cold climate of Tabriz.

Category	Architectural element	Specifications	Design requirements
A) Outer shell elements	Load-bearing walls	Thickness: 80-120 cm Material: Brick and mud	Natural thermal insulation, storage and regulation of internal temperature, resistance to extreme winter cold
	Central dome	Diameter: 15 m Height: 28 m Double layer (internal and external)	Creation of air insulation space between the two shells, natural ventilation through upper openings, reflection of natural light
	Vaulted ceilings	Intervals, multi-layered arches Thickness: 40-60 cm	Reduction of surface exposed to heat exchange, structural strength against earthquakes
	Small windows	Height from the floor: 150 cm Area: 15% of the wall surface	Reduction of heat loss, control of cold wind penetration, sufficient light entry without excessive heat exchange
B) Transitional spaces	Vestibule and entrance	Depth: 4-6 meters Height: 5 meters With double-layer door	Air-lock, preventing direct penetration of cold wind, temperature-regulating space between inside and outside
	Southern porch	Depth: 8 meters Height: 12 meters Direction: South	Receiving sunlight and heat in winter, shading in summer, semi-open space for mild season
	Deep corridors	Width: 3-4 meters Height: 4.5 meters Arched	Reducing heat exchange, creating a space protected from wind, connecting different spaces with minimal energy loss
C) Main worship spaces	Winter Shabestan	Area: 300 square meters Level: Basement Low vaulted ceiling	Smaller space for easier heating, use of geothermal energy, heat retention with small volume
	Summer Shabestan	Area: 400 square meters Level: Ground floor With more windows	Better natural ventilation, access to open courtyard space, seasonal flexibility
	Space under the dome	Diameter: 15 meters Height: 28 meters With upper openings	Natural vertical ventilation, central skylight, distribution of light and air to surrounding spaces
D) Yard and open space	Central courtyard	Area: 600 square meters Length to width ratio: 1.5:1 Enclosed by a wall	Protected microclimate, reduced wind speed, solar light and heat reception, building breathing space
	Limited green space	Area: 150 square meters Trees: Cypress and plane trees Floor: Paving stone	Shading in summer, reduced water evaporation due to dry climate, humidity retention

1.4. PASSIVE ENVIRONMENTAL SYSTEMS FOR ACHIEVING THERMAL COMFORT

Saheb-Ol-Amr Mosque exemplifies mastery in passive design strategies that provide comfort throughout the year without mechanical systems. The use of thermal mass in walls regulates diurnal temperature fluctuations, delaying heat release by up to ten hours. Vertical ventilation through the dome creates a natural chimney effect, promoting air circulation during summer. The building's southern orientation maximizes solar gain in winter while limiting overheating in summer. Windbreaks and northern blind walls effectively block cold drafts, further enhancing thermal performance. Double-layered vaults and the use of underground spaces stabilize temperatures, taking advantage of the earth's natural insulation. Small northern windows minimize heat loss, while the enclosed courtyard forms a protective microclimate. Collectively, these techniques demonstrate a comprehensive environmental strategy that balances light, heat, and airflow. This table 4 underscores how the mosque's passive systems achieved a sustainable equilibrium centuries before modern energy-efficient standards were introduced-proving the enduring relevance of traditional ecological intelligence in Islamic architecture.

Table 4. Passive systems for providing thermal comfort.

System	Mechanism of operation	Season of use	Effectiveness
Thermal mass of walls	Heat storage during the day and gradual release at night, time delay of 8-10 hours	Four seasons	Very High (★★★★★)
Vertical natural ventilation	Air movement from bottom to top (dome) openings, chimney effect	Summer	High (★★★★☆)
Southern orientation	Receiving maximum radiation in winter, shading in summer	Winter	High (★★★★☆)
Northern wall windbreak	Preventing the penetration of cold northern wind, reducing the permeability coefficient	Winter	Very High (★★★★★)
Double-layer vaulted ceilings	The air layer between the two shells acts as thermal insulation	Four seasons	High (★★★★☆)
Use of underground spaces	Taking advantage of the stable temperature of the earth (15-18 degrees)	Four seasons	Very High (★★★★★)
Small northern windows	Reducing heat loss and cold wind penetration	Winter	High (★★★★☆)
Enclosed courtyard	Creating a microclimate protected from the wind	Four seasons	Average (★★★☆☆)

1.5. THERMAL CHARACTERISTICS AND ENVIRONMENTAL ROLE OF BUILDING MATERIALS

Local materials form the foundation of the mosque's environmental and cultural resilience. Clay bricks, mud, and straw, produced in Tabriz kilns, provide exceptional thermal insulation while maintaining humidity balance. The use of local plaster and stone (sourced from Mount Sahand) reflects both aesthetic and climatic adaptation-offering durability, breathability, and moderate heat conductivity. Wood from walnut and mulberry trees contributes low thermal conductivity and adds a tactile warmth to interior spaces. The prevalence of native materials reduces embodied energy, carbon emissions, and transportation costs, aligning with modern sustainability principles. Furthermore, each material was selected for its climatic compatibility and cultural significance, reinforcing local identity. This table 5 exemplifies the symbiotic relationship between environment and material culture in traditional Iranian architecture. Through the integration of natural, recyclable, and locally sourced elements, the Saheb-Ol-Amr Mosque achieves environmental harmony, structural longevity, and aesthetic unity that modern architecture continues to learn from.

Table 5. Building materials and thermal properties.

Materials	Application	Thermal conductivity (W/m.K)	Origin	Climate Adaptation
Local clay bricks	Walls, domes, arches	0.6-0.8	Local kilns of Tabriz	Excellent (★★★★★)
Moor and straw	Wall cladding, covering	0.3-0.5	Native	Excellent (★★★★★)
Tabriz plaster	Facade, decorations, plastering	0.4-0.6	Mines around Tabriz	Good (★★★★☆)
Seven-color tiles	Exterior facade, dome, minaret	1.0-1.3	Workshops in Tabriz	Average (★★★☆☆)
Local igneous stone	Foundation, columns, courtyard floor	2.5-3.5	Mount Sahand	Good (★★★★☆)
Walnut and mulberry wood	Doors, windows, pulpit	0.15-0.20	Nearby gardens	Excellent (★★★★★)
Lime mortar	Facade, cladding	0.7-0.9	Native	Good (★★★★☆)

1.6. INTEGRATION OF THE MOSQUE WITH ITS URBAN AND ENVIRONMENTAL CONTEXT

The Saheb-Ol-Amr Mosque of Tabriz is a remarkable example of urban harmony and contextual integration. Its height, density, and scale are proportionally adjusted to the surrounding fabric, maintaining both visual coherence and symbolic prominence through the dome and minaret. The mosque's compact design, with shared walls and narrow alleys, reduces heat loss while fostering a sense of community enclosure. The physical-spatial organization allows seamless pedestrian access from multiple sides, reinforcing its role as a social and spiritual nucleus. Climatic harmony is achieved through mutual shading and wind protection offered by dense urban blocks, which raise local temperatures by several degrees in winter. The visual identity, characterized by Azeri-Islamic architectural motifs and turquoise tilework, strengthens the mosque's cultural symbolism within the city. Functionally, its adjacency to residential, commercial, and educational uses ensures constant activity and relevance. Overall, this table 6 highlights how environmental, spatial, and cultural coordination work collectively to create a sustainable and socially integrated architectural form-an enduring model for climate-conscious urban design rooted in traditional Islamic principles.

Table 6. Harmonizing the building with the environment and urban texture.

dimension	Index	Situation in Saheb-Ol-Amr Mosque	Rating
A) Physical-spatial coordination	Scale and Height	Building height (28 meters) in proportion to the surrounding context, minaret as an urban landmark, proportion to the street width (12 meters)	Excellent
		Building density 75%, in harmony with the dense historical context, common walls with neighboring buildings	Excellent
	Access Network	Entrance from three sides, connection to local alleys, 2-meter setback for the sidewalk	Good
	Visual Penetration	High enclosing walls, privacy, view of the dome and minaret from a distance	Excellent
B) Climate harmony with the environment	Mutual shading	Narrow alleys (4-6 meters), shading of adjacent buildings in summer, reducing wind speed in winter	Excellent
	Collective wind protection	Dense fabric as a wind shield, reducing wind speed by 40-	Excellent

c) Functional coordination	Local microclimate	50% at the alley level compared to the open space Creating a moderate climate, neighborhood temperature 2-3 degrees higher than outside the fabric in winter	Excellent
	Heat exchange	Common walls reduce the heat exchange surface with the outside, benefiting from the heat of adjacent buildings	Excellent
	Adjacency of uses	Residential (60%), Commercial (25%), Religious (10%), Educational (5%), Appropriate Functional Synergy	Excellent
	Activity of space	Multipurpose Use: Prayer, Ceremony, Gathering, Religious Education, Adaptable to Neighborhood Needs	Excellent
	Accessibility	400 Meter Pedestrian Access Radius, 85% Neighborhood Coverage, Connection to Public Transportation Routes	Good
D) Visual-identity coordination	Visual Identity	Azeri-Islamic architecture, turquoise blue tiling, dome and minaret as a symbol of the neighborhood	Excellent
	Facade Integrity	Materials consistent with the texture (brick, plaster), rhythm of walls and openings in harmony with the alley	Excellent
	Urban Readability	The role of the mosque as a landmark, spatial node, and social gathering center of the neighborhood	Excellent

1.7. ORIENTATION STRATEGIES AND COMPATIBILITY WITH SOLAR AND WIND AXES

The mosque's orientation and façade design represent a fine-tuned response to both religious requirements and environmental logic. The main southern front, aligned close to 180°, ensures maximum solar exposure during winter, providing passive heating and abundant daylight. In contrast, the northern façade is intentionally solid, with minimal openings to block cold winds from the Caucasus region. Eastern and western fronts are designed with moderate fenestration to balance light and heat intake, supporting comfort during morning and afternoon prayers. The Qibla axis at 215° southwest integrates liturgical orientation with climatic optimization, aligning sacred geometry with ecological wisdom. This dual orientation achieves thermal stability while reinforcing religious symbolism. Such careful alignment not only enhances natural energy performance but also strengthens the mosque's spiritual spatial experience. The table 7 exemplifies how environmental adaptation and religious orientation can coexist harmoniously, creating architecture that is both functionally sustainable and spiritually resonant.

Table 7. Orientation analysis and compatibility with the sun-wind axis.

Front	Direction	Architectural Elements	Climate performance
Southern Front	180° (South)	Main porch, larger windows, entrance space	Receiving maximum winter radiation, natural heating, sufficient light
Northern Front	0° (North)	Thick blind wall, small windows, service spaces	Protection from cold north wind, reducing heat loss, natural insulation
Eastern Front	90° (East)	Secondary entrance, medium windows, summer nave	Morning light, gentle heating, suitable for morning prayers

West Front	270° (West)	Semi-blind wall, limited openings, storage space	Protection from summer afternoon heat, reducing direct radiation
Qibla Axis	215° (Southwest)	Mihrab, main nave, dome	Combining religious and climatic needs, optimal orientation

1.8. EMPIRICAL MEASUREMENTS OF ENVIRONMENTAL PERFORMANCE PARAMETERS

Empirical data from field measurements confirm the mosque’s exceptional environmental performance. Indoor temperatures remain 12–23°C lower in summer and significantly warmer in winter compared to outdoor conditions, demonstrating the efficiency of passive insulation and thermal mass. Relative humidity levels inside the mosque are more stable, reducing dryness in summer and excess moisture in winter. The light intensity beneath the dome ranges from 350 to 500 lux, ensuring sufficient illumination without glare, while the shabestan offers softer, ambient lighting ideal for prayer. Wind speed within interior spaces is reduced by up to 80%, creating calm conditions conducive to contemplation. Acoustic measurements show a 30 dB reduction in external noise, achieved through the mosque’s spatial geometry and material density. Wall surface temperatures remain 20°C cooler under direct sunlight, preventing overheating. This table 8 verifies that traditional design strategies effectively deliver comfort and sustainability without mechanical intervention, validating centuries-old architectural intelligence through quantifiable environmental data.

Table 8. Field measurements of environmental parameters.

Parameter	Season/Time	Inside the mosque	Outside (open space)	Difference
Air temperature (°C)	Summer (Noon)	24-26	36-38	12-14 lower
	Winter (Noon)	16-18	0 to -5	16-23 higher
Relative humidity (%)	Summer	45-55	25-35	20% higher
	Winter	55-65	65-75	10% lower
Light intensity (lux)	Under the Dome (Noon)	350-500	80,000-100,000	Reduce direct radiation
	Shabestan	150-250	-	Ample natural light
Wind speed (m/s)	Courtyard	0.5-1.2	3.5-5.0	70-80% reduction
	Inside the Shabestan	0.1-0.3	-	Gentle flow
Sound level (dB)	Inside the Mosque	35-45	65-75	30 dB reduction
Wall radiant temperature (°C)	Summer (Noon)	26-28	45-50	20 degrees lower

*Measurements were taken under typical sunny conditions.

1.9. SUSTAINABILITY EVALUATION BASED ON LEED CRITERIA

A comparative analysis with LEED sustainability criteria reveals that Saheb-Ol-Amr Mosque aligns impressively with modern green building benchmarks. Its use of high-thermal-mass materials, natural ventilation, and optimized orientation achieve superior energy performance, equivalent to a “Gold” LEED rating with 84% total points. Over 90% of materials were locally sourced, minimizing transportation emissions, while the structure’s 200-year lifespan embodies exceptional durability and resource efficiency. The mosque’s interior provides thermal comfort across 85% of the year without mechanical systems, maintaining air quality through natural ventilation and non-toxic materials. Acoustic optimization and daylight penetration further enhance indoor environmental quality. While water management systems remain limited, opportunities exist for integrating modern rainwater collection and solar technologies. This table 9 demonstrates that the mosque’s traditional design achieves high sustainability standards long before such frameworks were formalized, positioning it as a living prototype for environmentally conscious architecture rooted in cultural authenticity.

Table 9. Comparison with contemporary sustainable architecture standards (LEED).

Category	Indicator	Status in the Mosque	Score
Southern Front	Thermal insulation	Thick brick walls, double-layered dome, vaulted ceilings	9/10
	Natural lighting	Side windows, light dome, 75% reduction in daytime electricity consumption	8/10
	Natural ventilation	Vertical dome system, reciprocal windows, 60% reduction in mechanical ventilation requirements	8/10
	Optimal orientation	South-southwest, taking advantage of winter sun	9/10
Materials and resources	Native Materials	90% materials from 50 km radius, reducing carbon footprint	10/10
	Recycled Materials	Brick, plaster, recyclable stone, 200+ year useful life	9/10
	Environmental Impacts of Production	Low energy materials (clay brick, mud mortar), no industrial pollution	9/10
Indoor environment quality	Thermal comfort	Indoor temperature 18-26 degrees without mechanical system, 85% of the year	9/10
	Air quality	Continuous natural ventilation, VOC-free materials, 95% fresh air	10/10
	Acoustics	Optimized reverberation time, dome design for sound diffusion, 30 dB reduction of outside noise	8/10
Water management	Water Consumption	Limited drip irrigation system, low water green space	6/10
	Rainwater Collection	Limited system, roof slope towards the yard	5/10
Design innovation	Native Solutions	Combining traditional knowledge and climatology, a generalizable model	10/10
	Flexibility	Multipurpose spaces, adapting to changing needs	9/10
Total points			118/140
Total percentage			84%
LEED rating equivalent			Golden

1.10. ISLAMIC ARCHITECTURAL PATTERNS APPLICABLE TO CONTEMPORARY DESIGN

The architectural principles evident in Saheb-Ol-Amr Mosque possess strong potential for contemporary adaptation. Its introverted layout with a central courtyard provides privacy, climatic regulation, and social cohesion-concepts highly relevant to modern housing and educational complexes. Thick brick walls and double-layer domes ensure thermal balance, applicable to low-energy and large-span structures alike. Vertical ventilation through domed perforations offers a natural solution for high-rise and commercial buildings. The hierarchical arrangement of transitional spaces (hashti, corridors, porches) maintains thermal moderation and spatial rhythm. The strategic south-north façade design-large southern openings and minimal northern windows-remains a universal strategy for climate-responsive design. Use of local materials and flexible spaces reflects sustainability and adaptability. This table 10 distills timeless design wisdom into principles that remain fully generalizable for modern architectural contexts. It underscores how traditional Islamic architecture can

guide the creation of energy-efficient, culturally meaningful, and human-centered environments in contemporary practice.

Table 10. Islamic architectural patterns that can be generalized in contemporary design.

Architectural Pattern	Application in Saheb-ol-Amr Mosque	Contemporary Generalizability	Priority
Introverted design	Central courtyard, closed facade, rich interior spaces	Residential complexes, cultural centers, schools	Very high
High thermal mass walls	80-120 cm brick wall, natural temperature regulation	Low-energy buildings, cold areas	Very high
Double layer dome	Inner and outer shell with air space between them	Large roofs, sports halls, exhibition centers	High
Natural vertical ventilation	Perforations on top of the dome, vertical air flow	High-rise buildings, atriums, shopping centers	Very high
Climatic orientation	South: large opening, North: blind wall	All new buildings	Very high
Transitional spaces	Hashti, portal, deep corridors	Building entrances, space connections	High
Vaulted ceilings	Drills, drum arches, insulated and resistant	Public space roofs, wind structures	High
Local materials	Brick, plaster, local stone, mud mortar	Sustainable architecture, green construction	Very high
Spatial flexibility	Winter-summer dormitories, multiple uses	Office, commercial, educational spaces	High
Enclosed courtyard	Microclimate, breathing space, wind protection	Residential complexes, hospitals, schools	Very high
Small windows on the windward side	North: small openings 15% of the wall surface	Cold areas, windy areas	High
Use of the basement	Winter dormitory, benefit from the stable temperature of the earth	Low-energy buildings, storage spaces	High

1.11. SWOT ANALYSIS OF ENVIRONMENTAL COMPATIBILITY

The SWOT analysis highlights the mosque's resilience and challenges from an environmental perspective. Its key strengths include excellent insulation, optimal natural ventilation, and extensive use of local materials, resulting in over 70% energy savings compared to conventional buildings. Weaknesses such as limited rainwater collection, lack of renewable systems, and restricted accessibility suggest areas for modern enhancement. Opportunities lie in developing the site into a heritage-based sustainability model, installing solar panels, and transforming it into a training hub for ecological design. Threats include climate change, regional earthquakes, and the gradual erosion of traditional construction knowledge. Despite these challenges, the mosque remains a living example of harmony between architecture and environment. This table 11 not only reveals the mosque's sustainable potential but also calls for the preservation and modernization of traditional systems through careful integration with new technologies-ensuring its continued relevance in the 21st century.

Table 11. SWOT analysis of environmental compatibility of the mosque.

Strengths (S)	Weaknesses (W)	Opportunities (O)	Threats (T)
✓ Excellent thermal insulation with thick walls	X Limited rainwater management system	+ A generalizable model for contemporary architecture	⚠ Climate change and increasing extreme temperatures
✓ Optimal natural ventilation and lighting	X Little green space (only 150 square meters)	+ Potential for religious and architectural tourism	⚠ Earthquakes in the region
✓ Use of 90% local and sustainable materials	X No use of renewable energy	+ Possibility of installing solar panels on the roof	⚠ Deterioration of the surrounding fabric

✓ Suitable climatic orientation (south-southwest)	X No smart technologies	+ Development of existing underground spaces	⚠ Excessive urban development
✓ Efficient passive systems	X Limited access for the disabled	+ Creation of a museum of Islamic architecture	⚠ Air pollution and acidification
✓ Spatial flexibility (winter-summer)	X Traditional sanitary facilities	+ Training ground for architecture students	⚠ Lack of maintenance budget
✓ Complete harmony with the historical context	X No modern fire extinguishing system	+ UNESCO World Heritage Site	⚠ Forgetting traditional construction knowledge
✓ High useful life (200+ years)	X Insufficient parking space	+ Inspiration for sustainable designs	⚠ Increasing need for modern facilities
✓ 70% reduction in energy consumption compared to a conventional building			

1.12. SUMMARY OF KEY FINDINGS AND DESIGN RECOMMENDATIONS

The summary table synthesizes key findings and translates them into actionable recommendations for modern architecture. The mosque's capacity to maintain 12–23°C temperature differences without mechanical systems underscores the effectiveness of high-thermal-mass walls and passive ventilation. Its optimized orientation, enclosed courtyard, and local material use collectively reduce energy consumption by 70%. The design lessons drawn from this structure emphasize prioritizing passive strategies over active systems, using south-facing openings for light and heat, and integrating dense urban fabrics for wind protection. The findings affirm that indigenous architecture inherently embodies sustainable principles long before they became academic concerns. This table 12 serves as a bridge between historical knowledge and contemporary design practice, encouraging architects to adapt traditional wisdom for modern efficiency. By translating these principles into today's context, designers can achieve buildings that are ecologically responsible, culturally rooted, and emotionally resonant-mirroring the enduring legacy of Saheb-Ol-Amr Mosque.

Table 12. Summary of findings and practical recommendations.

Domain	Key Findings	Recommendations for contemporary design
Thermal Adaptation	Reduced 12-23 degrees of temperature difference between inside and outside without mechanical systems	Use of high thermal mass in walls (minimum 60 cm)
Lighting	75% reduced need for artificial lighting during the day	Design of light domes and appropriate side windows
Ventilation	70-80% reduced wind speed and sufficient natural ventilation	Vertical ventilation system using tall spaces
Materials	90% indigenous materials, 200+ year lifespan	Priority on local materials with low conductivity
Orientation	95% compatibility with south facade, 100% protection from north	South: large openings, North: blind wall or small opening
Open Space	Enclosed courtyard creates 2-3 degrees warmer microclimate	Design of central courtyard/atrium in public buildings
Texture Coordination	Dense fabric reduces wind speed by 40-50%	Dense design with shared walls in cold climates
Energy	70% reduced energy consumption compared to a conventional building	Priority on passive design before active systems

2. CONCLUSION

The Saheb-Ol-Amr Mosque of Tabriz is a prominent example of environmental sustainability in Islamic architecture, achieving 84% of the score (equivalent to LEED Gold rating), demonstrating the high ability of traditional architecture to respond to climate challenges. Through 12 key patterns, including high thermal mass

walls, natural vertical ventilation, optimal orientation, and the use of local materials, this building has achieved a 70% reduction in energy consumption compared to a conventional building. The building's complete harmony with the urban fabric of Tabriz and the creation of a protected microclimate demonstrate the holistic approach of Islamic architecture in environmental sustainability. These findings can provide a generalizable model for the design of contemporary low-energy buildings in cold climates.

Sustainability Score	Reduced Energy Consumption	Local Materials
84%	70%	90%