Architectural Legacy and Urban Dynamics: Analysing the Vernacular Structures of Maktampur, Gulbarga

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Abstract— This paper delves into the vernacular architecture of Maktampur, a historic district in Gulbarga, focusing on its role in encapsulating the historical and cultural identity of the region. The study examines traditional building materials, construction methods, and architectural styles, revealing how these elements have shaped the distinct urban fabric of the city. Detailed case studies of significant historical structures demonstrate the adaptation of vernacular architecture to the local climate and social needs. The research highlights how traditional practices address the semi-arid environment through techniques such as thermal mass, compact layouts, and strategic orientation, which collectively enhance comfort and sustainability. Additionally, the paper addresses contemporary challenges faced in preserving these architectural gems amidst rapid urbanization and modernization pressures. It discusses the impact of modern development on the integrity of historical structures and proposes conservation strategies aimed at preserving their cultural and historical significance. The study also explores the potential for integrating traditional architectural principles into contemporary urban planning, suggesting that such integration can improve the functionality and sustainability of modern urban environments. By proposing methods to balance preservation with development, this research seeks to provide valuable insights into maintaining the relevance of historical architectural practices while accommodating contemporary urban needs.

Index Terms- Vernacular Architecture, Urban Fabric, Cultural Heritage, Historical Architecture Integration, Human scale etc.

I. INTRODUCTION

Gulbarga, an ancient city in Karnataka, India, stands as a testament to the rich historical and cultural legacy of South India through its distinctive vernacular architecture. This architecture, deeply rooted in local traditions and environmental adaptations, offers a vivid reflection of the city's historical evolution and cultural ethos. Characterized by the use of local materials, traditional construction methods, and design elements adapted to the region's climate and social practices, Gulbarga's built environment presents a harmonious blend of functionality and aesthetic appeal shaped over centuries.

Key architectural features include traditional homes, religious buildings, and public spaces, each illustrating how historical communities interacted with their surroundings. Despite its historical significance, Gulbarga's vernacular architecture faces considerable challenges today. Rapid urbanization, modernization, and neglect pose threats to these architectural treasures, jeopardizing the preservation of a vital link to the city's past.

II. PURPOSE OF STUDY

This study explores the vernacular architecture of Maktampur, Gulbarga, focusing on how traditional building practices reflect the region's cultural identity and climatic conditions. By analysing the use of local materials, construction methods, and design elements, the research aims to highlight the architectural evolution and significance of these structures. It also addresses current preservation challenges amidst rapid urbanization, proposing strategies to integrate vernacular principles into modern urban planning to protect and sustain Gulbarga's architectural heritage.

III. GULBARGA LOCATION

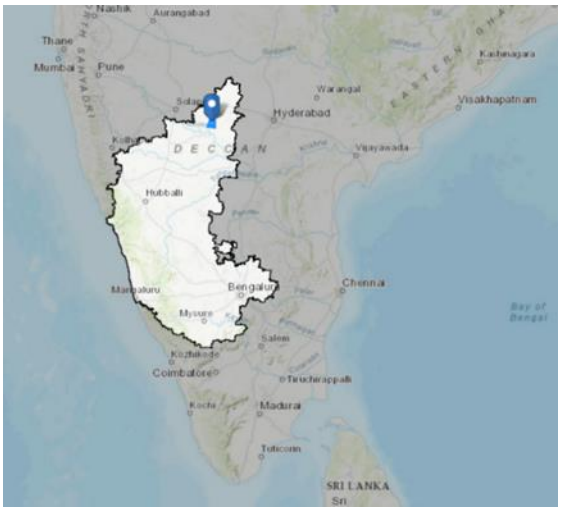

Fig.1. Gulbarga location map

Gulbarga is located in the northern part of Karnataka, India. It lies at a latitude of approximately 17.34° N and a longitude of 76.83° E, at an elevation of about 454 metres (1,490 feet) above sea level. The city is part of the Deccan Plateau and is situated roughly 623 km northwest of Bangalore, the state capital.

IV. CLIMATE

Climate data for Kalaburagi (1981–2010, extremes 1901–2012) [hide]

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
Record high °C (°F)	36.2 (97.2)	39.4 (102.9)	43.0 (109.4)	45.1 (113.2)	46.1 (115.0)	46.0 (114.8)	38.4 (101.1)	37.8 (100.0)	37.4 (99.3)	38.2 (100.8)	35.6 (96.1)	35.1 (95.2)	46.1 (115.0)
Mean daily maximum °C (°F)	31.3 (88.3)	34.4 (93.9)	37.8 (100.0)	40.2 (104.4)	40.6 (105.1)	35.6 (96.1)	32.3 (90.1)	31.3 (88.3)	32.1 (89.8)	32.3 (90.1)	31.4 (88.5)	30.5 (86.9)	34.2 (93.6)
Mean daily minimum °C (°F)	16.3 (61.3)	18.6 (65.5)	22.3 (72.1)	25.1 (77.2)	25.8 (78.4)	23.8 (74.8)	23.0 (73.4)	22.5 (72.5)	22.6 (72.7)	21.2 (70.2)	18.5 (65.3)	15.8 (60.4)	21.3 (70.3)
Record low °C (°F)	6.7 (44.1)	9.4 (48.9)	12.8 (55.0)	13.3 (55.9)	17.8 (64.0)	12.7 (54.9)	17.2 (63.0)	16.4 (61.5)	17.8 (64.0)	10.0 (50.0)	7.8 (46.0)	5.6 (42.1)	5.6 (42.1)
Average rainfall mm (inches)	4.1 (0.16)	1.9 (0.07)	5.9 (0.23)	17.2 (0.68)	26.0 (1.02)	109.4 (4.31)	127.1 (5.00)	152.8 (6.02)	194.2 (7.65)	99.9 (3.93)	19.7 (0.78)	4.2 (0.17)	762.3 (30.01)
Average rainy days	0.4	0.1	0.5	1.4	2.3	6.4	8.9	8.9	9.0	5.4	1.6	0.2	45.0
Average relative humidity (%) (at 17:30 IST)	34	28	23	23	28	48	58	61	60	52	43	37	41

Fig.2. Climate data of Gulbarga

Gulbarga experiences a semi-arid climate characterized by scorching summers, with temperatures exceeding 40°C, and mild winters. The region sees moderate annual rainfall (700-800 mm) during the monsoon season, while humidity remains low to moderate. Intense solar radiation and dry conditions dominate most of the year. Understanding these climatic conditions is essential for designing thermally efficient buildings, focusing on passive cooling, optimal orientation, and proper ventilation. Effective water management during the monsoons, along with the use of high thermal mass materials, shading, and green spaces, can significantly enhance comfort and sustainability in the built environment.

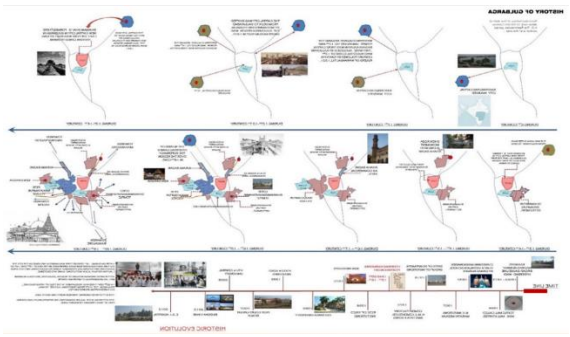

Fig.3. City evolution map, Gulbarga

V. HISTORICAL OVERVIEW

5.1 HISTORICAL SIGNIFICANCE

1. Medieval Period: Gulbarga was an important city during the medieval period under the Bahmani Sultanate, which established its capital here in the 14th century. The city was a major political and cultural hub, known for its distinctive Islamic architecture and administrative prowess.
2. Architectural Heritage: The Bahmani Sultanate left a lasting impact on Gulbarga's architectural landscape, with structures such as the Gulbarga Fort, Jumma Masjid, and various tombs and dargahs reflecting the era's distinctive style. These buildings feature a blend of Persian and Indian architectural elements, including domes, minarets, and intricate carvings.
3. Post-Bahmani Era: After the decline of the Bahmani Sultanate, Gulbarga came under the rule of various regional powers, including the Vijayanagara Empire and the Deccan Sultanates. Each of these regimes contributed to the city's architectural and cultural evolution.
4. Colonial Period: During British rule, Gulbarga continued to develop but remained a focal point for its rich historical heritage. The colonial influence introduced new administrative and educational structures, adding to the city's architectural diversity.

5.2 CULTURAL SIGNIFICANCE

1. Religious Diversity: Gulbarga is notable for its religious diversity. It has a significant presence of Islamic and Hindu communities, which is reflected in its architectural and cultural landscape. Temples, mosques, and dargahs coexist, representing the city's historical pluralism.

2. Cultural Heritage: The city is renowned for its cultural heritage, including traditional crafts, festivals, and cuisine. Gulbarga's cultural life is a blend of various traditions, influenced by its historical rulers and local customs.
3. Educational Contributions: Gulbarga has been a center of learning and scholarship, especially during the Bahmani period. The city has historical connections to Islamic scholarship and education, with notable institutions and scholars contributing to its intellectual legacy.

VI. PLANNING PRINCIPLES MAKTAMPUR, GULBARGA

6.1 ORIENTATION OF LAYOUT

North-South and East-West Axis: Streets in Gulbarga were laid out in a grid pattern, primarily aligned along the north-south and right-angle intersections of its streets and lanes, which divided the city into numerous rectangular blocks. This orientation allowed for efficient circulation and facilitated urban planning.

Climatic Considerations: The orientation of streets and buildings may have also been influenced by climatic factors, such as maximising airflow for ventilation or minimising heat gain during the day, which would have been essential in the hot dry climatic region.

Compact Planning: As Gulbarga situated in Semi-arid climatic region, built form is compact and is ideal for enhancing thermal comfort and energy efficiency. Compact forms minimize surface area exposed to solar radiation, reducing heat gain. The reduced external wall area also helps in maintaining cooler indoor temperatures by limiting heat transfer.

Narrow streets, dense layouts, and clustered buildings provide mutual shading, lowering overall temperature in outdoor spaces. Courtyards, commonly integrated within compact forms, act as cooling zones by allowing natural ventilation. In addition, compact designs promote efficient land use, conserve water resources, and support sustainable living, essential for semi-arid regions with harsh climatic conditions.

Natural Ventilation: Layouts allow for cross-ventilation by aligning streets and buildings with prevailing wind directions, enhancing airflow and cooling.

Fig.4. aktampur(16th-17th century older settlement), Gulbarga figure ground map

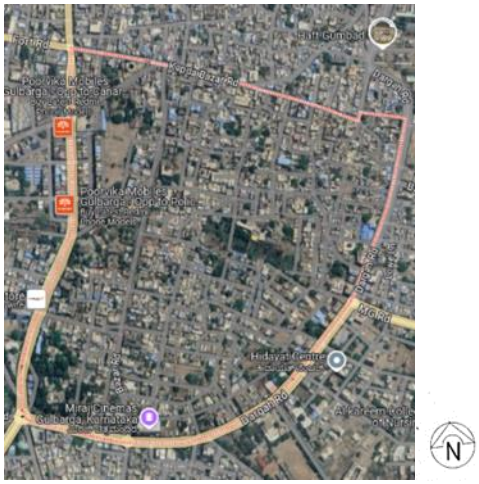

Fig.5. Maktampur, Gulbarga satellite map

OUTDOOR BETWEEN SPACES AND STREETS

Orientation: Align outdoor spaces to maximize shade and reduce exposure to the midday sun. Consider the

angle of sunlight and prevailing wind directions when designing layouts.

Community Spaces: Design narrow streets to accommodate community gatherings or social interaction, ensuring they remain functional and comfortable for social activities. Verandas play very important role.

Local Practices: Integrate local architectural and cultural elements to enhance the relevance and acceptance of outdoor spaces. Traditional designs and materials often provide practical solutions to climate challenges.

Building Overhangs: Design buildings with deep overhangs or cantilevered balconies to provide shade for pedestrians and reduce direct sunlight on the street.

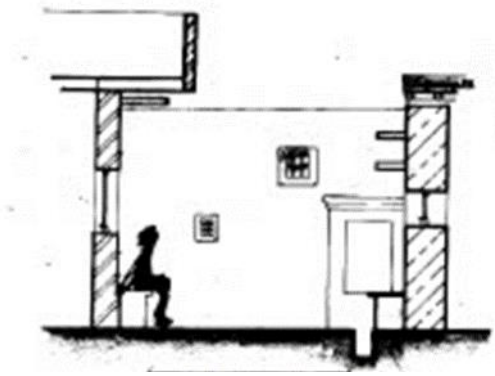

Fig.6. Section of street showing seating

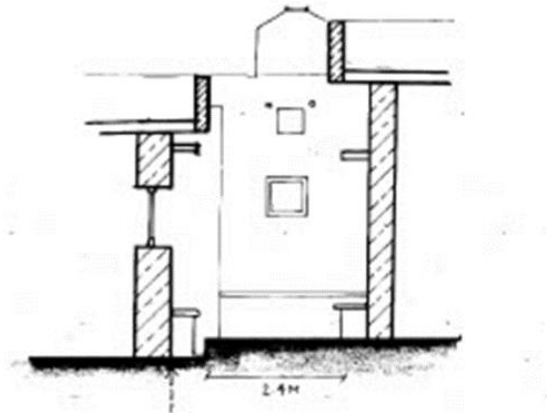

Fig.7. Section of street

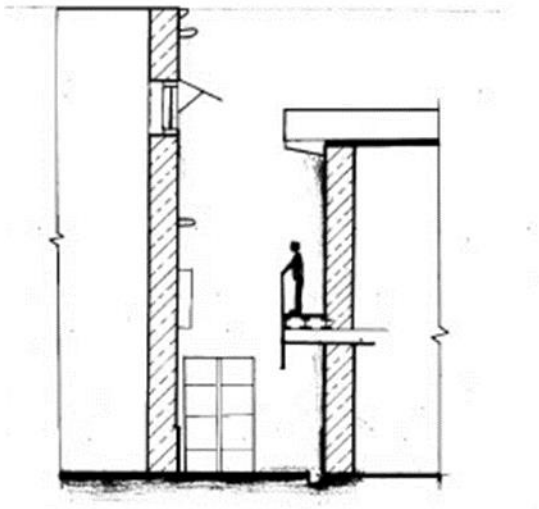

Fig.8. Section of street cutting balcony

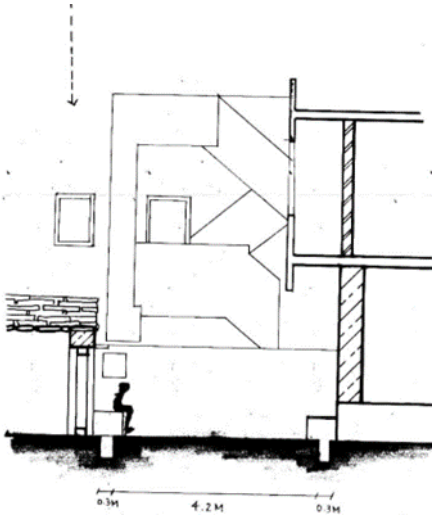

Fig.9. Section of street

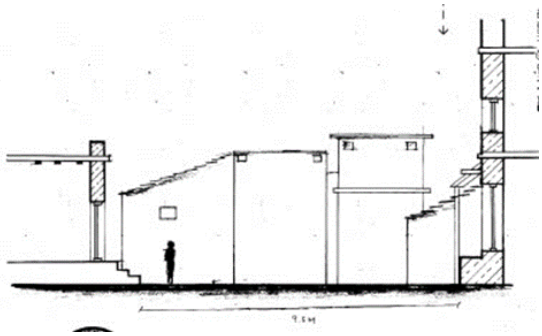

Fig.10. Section of street showing seating

6.2 PLANNING HOUSES

- Rectangular Plan
- Central access

- Courtyard house
- Human scale
- Thick walls
- Less and small size openings
- All cases are older than 200 years

In tropical hot-dry climates, compact plans are highly effective as they reduce the amount of exterior surface exposed to intense solar radiation. This design approach minimizes heat gain and enhances indoor comfort. Deeper rooms are particularly advantageous as they limit direct exposure to outside heat, helping to maintain cooler indoor temperatures.

Inward-looking layouts are well-suited for such climates as they offer protection from external solar heat and radiation. By focusing the design inward, these plans shield interiors from the harsh elements outside. Incorporating courtyards, along with trees and small water bodies, significantly contributes to creating a cool microclimate. The evaporation cooling effect from these features helps to lower temperatures and improve overall comfort.

To further mitigate heat gain, it is crucial to use thicker external walls and limit the number of windows. This approach reduces the impact of solar radiation and enhances thermal insulation. Additionally, heat-producing areas should be strategically separated from other parts of the house to prevent excessive heat transfer. This separation helps maintain a more consistent and comfortable indoor environment, effectively managing the challenges of a hot-dry climate.

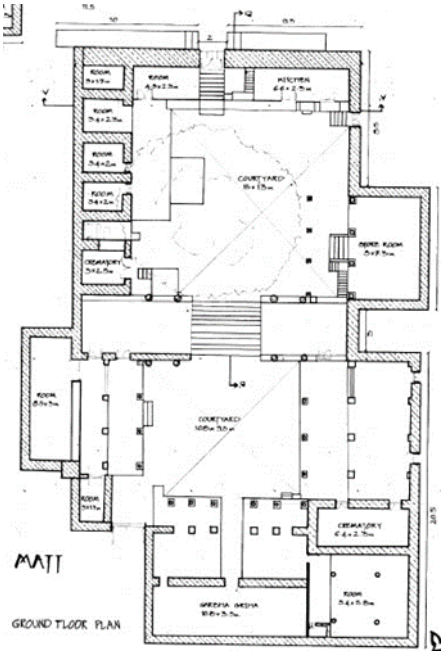

Fig.11. Case 1 - Gadagi matt Ground floor plan

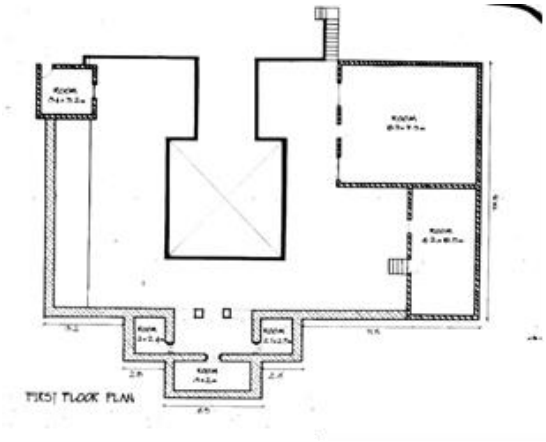

Fig.12. case 1 - Gadagi matt first floor plan

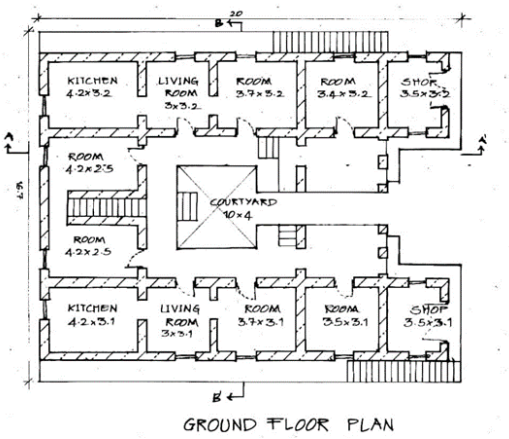

Fig.13. case 2 – Nagamma House ground floor plan

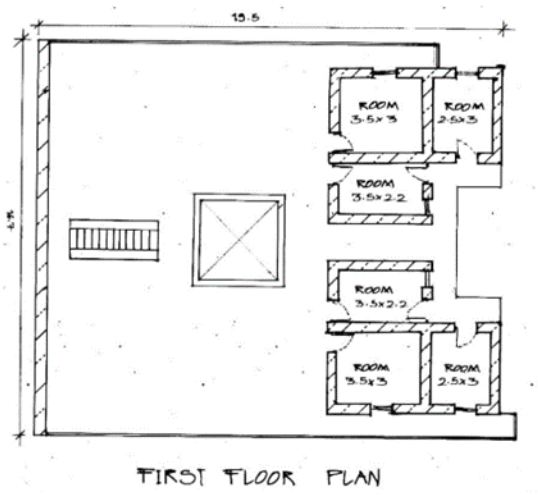

Fig.14. case 2 – Nagamma House first floor plan

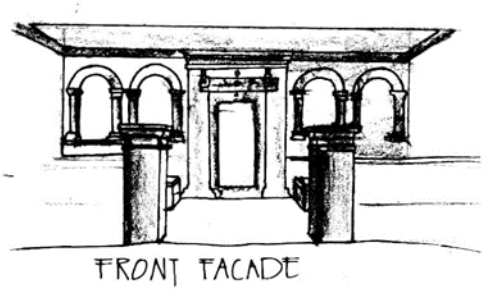

Fig.15. case 2 – Nagamma House first facade

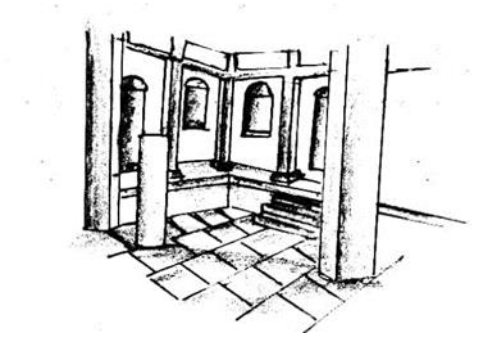

Fig.16. case 2 – Nagamma House courtyard

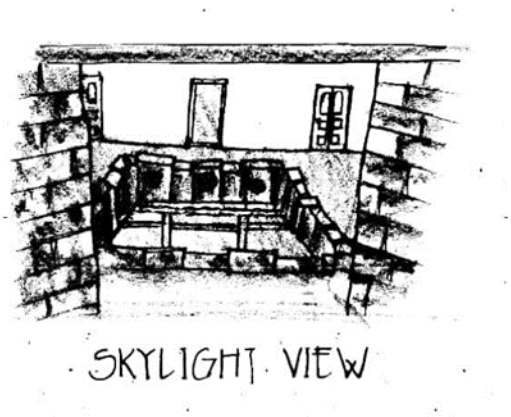

Fig.17. case 2 – Nagamma House skylight

Openings: In Semi-arid regions, buildings typically feature fewer and smaller openings to minimize heat gain and reduce the entry of hot, dry air. Small windows and limited openings help maintain a cooler indoor environment by reducing direct sunlight exposure and controlling airflow. Additionally, these smaller openings are often strategically placed to allow for ventilation without letting in excessive heat, ensuring the building stays cooler during the day while still benefiting from controlled airflow for comfort. This design approach also minimizes the amount of dust and hot winds entering the building.

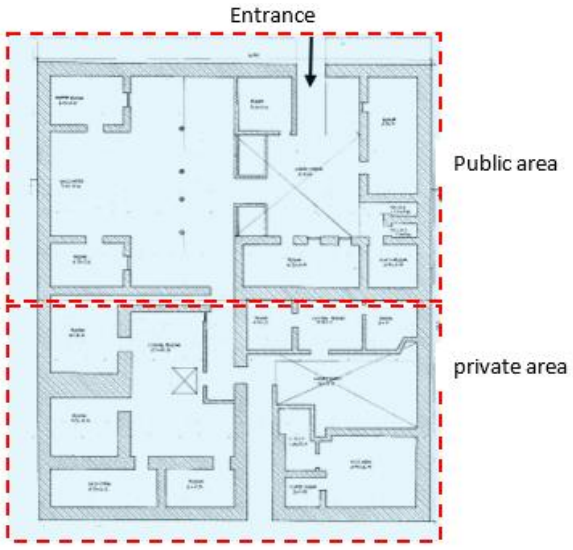

Fig.18. case 3 – Mansabdar house ground floor plan

Built 300-year-old

Occupation of owner: Before independence revenue collector.

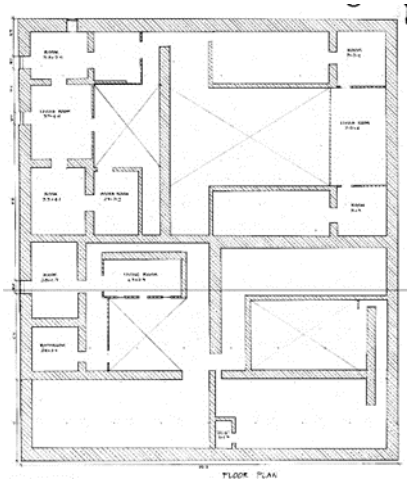

Fig.19. case 3 – Mansabdar house first floor plan

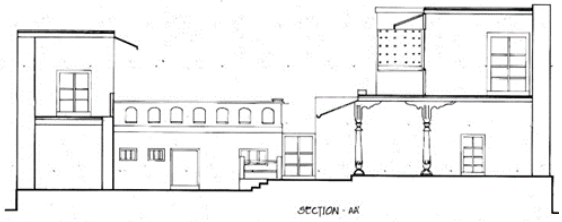

Fig.20. case 3 – Mansabdar house section through courtyard

In Figures 18, 19, and 20, the Mansabdar house features a double courtyard layout that effectively separates private and public spaces. The outer courtyard is designed for public activities and office use, providing an accessible and open area ideal for social interactions and community functions.

In contrast, the inner courtyard serves as a private retreat for family activities and relaxation, offering a secluded and serene environment away from public view. This layout not only enhances functionality by clearly demarcating communal and personal areas but also adapts to cultural practices and climatic conditions. The design balances privacy with social engagement, ensuring comfort and usability in alignment with traditional values and environmental considerations. By integrating these elements, the Mansabdar house achieves an optimal blend of openness and seclusion, catering to both social needs and personal retreat within the home.

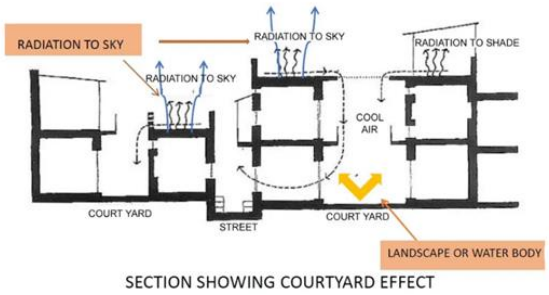

Fig.21. Typical section showing courtyard effect

Courtyard planning is particularly effective in hot and dry and semi-arid climates. Courtyards are usually centrally located and can be fully open to the sky or partially shaded with overhangs, which helps to reduce heat gain by providing shaded areas. The central courtyard not only brings natural light to all surrounding spaces but also facilitates air movement through induced ventilation from openings in the walls facing the courtyard.

In such climates, large courtyards enhance ventilation, especially when they open onto other courtyards or streets, promoting cross-ventilation. Smaller courtyards, meanwhile, offer protection from hot, dusty winds common in dry regions.

The courtyard's thermal performance follows a day and night cycle:
Night Phase: Cool air from the night settles in the courtyard and surrounding rooms, cooling the structure and furnishings, which stay cool until late afternoon.

Daytime Phase: At midday, direct sunlight heats the courtyard floor, causing warm air to rise and escape. This process creates convective currents that can provide additional comfort. The courtyard functions as a chimney while thick walls delay the penetration of external heat.

Evening Phase: By late afternoon, the courtyard and interior rooms warm up as trapped cool air escapes. After sunset, the courtyard rapidly radiates heat to the clear night sky, and cool night air descends, completing the cooling cycle.

This cyclical process effectively manages indoor temperatures and maintains comfort in hot, dry climates.

Human scale: Vernacular architecture is to human proportions, needs, and experiences. It integrates cultural and environmental contexts to create comfortable and accessible spaces. Buildings are designed with relatable dimensions, using local materials like mud, stone, or timber, which reflect the region's resources. Courtyards, verandas, and semi-open spaces blur the line between indoors and outdoors, adapting to daily activities and climate. Functionality is key, with thick walls and small windows reducing heat gain in hot climates. These designs embody cultural expression, fostering a strong connection between people, their community, and environment.

6.3 Construction technique and material

- Thick wall
- Load bearing wall
- Stone construction -Lime stone and black basalt stone
- Thick multi layered mud roof and lime stone roof.

Thick Walls: Thick walls are commonly used to insulate interiors from the extreme heat. They slow down heat transfer, keeping indoor spaces cooler during the day and releasing stored heat at night.

Load-Bearing Walls: These walls provide structural support and are often made from durable local materials like stone, contributing to both stability and thermal mass, which helps regulate indoor temperatures.

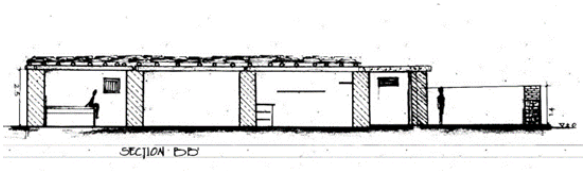

Fig.22. Typical section showing 60cm to 90cm thick wall

Stone Construction: Stone is a prominent building material in Gulbarga, particularly limestone and black basalt, both abundant in the region. These stones are durable and provide excellent thermal mass, which is crucial in maintaining cooler indoor temperatures. These stones have a high thermal capacity, absorbing heat during the day and releasing it at night, helping regulate the building's temperature.

Fig.23. Stone wall

Fig.24. Stone wall

Fig.25. Stone wall

Thick, Multi-Layered Mud Roof and Limestone Roof: The roof thickness in traditional construction ranges from 25 cm to 45 cm, with two primary types of construction:

- First Type: Roofs are covered with 2-inch-thick stone slabs, supported by closely spaced wooden beams and joists. These are topped with lime mortar, and a mud layer is added above the stone slab. This substantial roof thickness provides a longer time lag, delaying heat entry, making it effective in hot climates.
- Second Type: This uses jungle-cut wooden logs, with 1- to 2-inch-thick stone slabs laid over them in a sloping format. This design ensures effective rainwater drainage without penetration while maintaining thermal insulation.

Fig.26. lime stone roof.

VII. RESULTS AND DISCUSSION

The analysis of Maktampur's vernacular architecture highlights its crucial role in shaping the historical and cultural identity of Gulbarga. Traditional construction methods, such as the use of thick stone walls and multi-layered mud roofs, have effectively addressed the challenges posed by the region's semi-arid climate. The compact planning of buildings, with inward-looking layouts and central courtyards, enhances natural ventilation and thermal comfort, demonstrating a sophisticated understanding of climate adaptation.

However, the rapid pace of urbanization poses significant threats to these architectural treasures. The influx of modern development often disregards the historical and cultural values embedded in vernacular structures. The loss of traditional techniques and materials further exacerbates the erosion of architectural heritage.

Preservation efforts must focus on balancing modernization with the conservation of traditional architectural practices. By integrating vernacular design principles into contemporary urban planning, cities can maintain their historical essence while adapting to new challenges. The recommendations provided aim to address these issues by promoting preservation policies, community engagement, and educational initiatives, ensuring that the architectural legacy of Maktampur continues to enrich the cultural landscape of Gulbarga.

CONCLUSION

1. The analysis of traditional architectural reveals their vital role in meeting the social, structural, climatic, and functional demands of their time. The challenge today is to rationalize, coordinate, and integrate these elements into contemporary architecture, acknowledging vernacular architecture evolved by incorporating earlier civilizations. The consideration of technological advancements and modern development is essential for this integration.
2. In vernacular architecture, spaces between buildings are essential for shaping urban and rural environments. They provide functional separation, organizing different areas. These interstitial spaces enhance natural ventilation and light penetration, which is crucial in dense areas. They balance privacy and social interaction, offering both community engagement and personal space. Designed for climate adaptation, they offer shade and cooling in hot climates or conserve heat in cold regions. They also manage water runoff, reflect cultural aesthetics, and facilitate access and connectivity. Additionally, they act as buffer zones between varying land uses, enhancing liveability and mitigating conflicts.
3. Special attention must be paid to the design of internal courtyards, which act as a bridge between internal and external environments. Courtyards significantly impact the social and cultural dynamics of communities, and it is crucial to balance their functional and aesthetic values. Success in functional design should not overlook cultural, social and climatical aspects.
4. Additionally, existing building codes must be improved to maintain the local character while

aligning with the principles of Vernacular architecture.

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