



UNIVERSITAT
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HARNESSING THE WIND: VERNACULAR WISDOM AND AI IN THE URBAN DEVELOPMENT OF YAZD

CASE STUDY: BADGIRS AND PASSIVE COOLING SYSTEMS IN THE HISTORIC CITY OF YAZD, IRAN



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INTRODUCTION

The city of Yazd, located between two major deserts in Iran, has thrived for centuries despite its extreme climate. With high solar radiation, hot winds, and minimal vegetation, its survival depends on the integration of architecture and natural forces, especially wind. This research investigates how vernacular architectural elements—such as badgirs (windcatchers), sabats, domes, and courtyards—have shaped urban development by harnessing wind energy through passive cooling systems.

OBJECTIVES

- Analyse the role of wind energy in shaping Yazd's urban morphology and architecture.
- Understand how elements like badgirs, sabats, and courtyards interact with climatic forces.
- Explore how AI tools can help simulate, adapt, and localize these strategies for modern urban design.
- Promote the integration of vernacular knowledge with contemporary climate-responsive architecture.

METHODOLOGY

1. **Literature Review:** Passive cooling systems, wind architecture, and sustainability in desert cities.
2. **Case Study Selection:** Yazd – UNESCO World Heritage City. Focus on the Fahadan neighbourhood.
3. **Field Research in Iran**
4. **Architectural Drawings & Modelling:** Digital mapping of urban form using AutoCAD, Rhino, and other tools.
5. **Data Organization:** Classification of spatial elements into articles and PhD thesis chapters.
6. **Next Phase – AI Integration:**
 - Use machine learning & CFD simulations to analyze airflow and optimize design.
 - Explore predictive models for localizing wind-based solutions in other climates.

CONCLUSION & OUTLOOK

- Yazd presents a highly intelligent wind-based architectural system that is both aesthetic and functional.
- AI offers a unique opportunity to preserve, simulate, and reapply these vernacular strategies in modern contexts.
- The project is entering its final stages, with continued work on 3D models, simulation, and academic dissemination.
- Broader themes include the role of open urban spaces, clean energy localization, and sustainable design in diverse global climates.
- This fusion of ancient wisdom and AI can inform resilient, low-carbon urban futures.

RESULTS & PROGRESS

- Identified a strong correlation between urban orientation and wind flow in Yazd.
- Badgirs and sabats were found to significantly reduce indoor temperatures.
- Initial AI simulations suggest that traditional principles can be algorithmically adapted.
- Ongoing work includes digital modeling and data structuring for cross-case analysis.

