RESILIENCE THRIFT

URBAN AIRFLOW IN INFORMAL SETTLEMENTS: EXAMINING HUMAN ADAPTATION TO SKIMMING FLOW

Dainty Doe Justin
UUR20259

Guided by
Prof. Melissa K. Smith

Faculty of Planning
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This project would not have been possible without the encouragement, critiques, questions and care from my family :)

Preface

Human beings have always been curious. First, about the things we can see, and touch — then, gradually, about the things we hear and sense. As we evolved and exhausted the tangible world around us, our curiosity turned inward. Not toward the biological workings of our bodies — surgeries and medicine have long attended to that — but toward the intangible world of human thought, behaviour, and emotion. Philosophers, psychologists, and thinkers have spent lifetimes trying to unravel what shapes us, what drives us, and what satisfies us.

At the centre of this lies a simple yet elusive idea: comfort. Is it found in food, in clothing, in the spaces we inhabit, or the people we surround ourselves with? Is comfort essential for survival, or is it a privilege, abandoned by those who cannot afford it? When denied comfort, do people adapt — and in doing so, does their definition of comfort change?

In a world where environmental shifts and climate anxieties now frame our everyday lives, human behaviour continues to evolve. We no longer live, act, or adapt as our predecessors did — for better or worse. And perhaps, in these small, quiet adaptations, lies the story of how we negotiate comfort in a changing world.

Abstract

This study explores the impact of ventilation on wind comfort in informal settlements, focusing on human behaviour and adaptation. Unlike formal urban areas, where wind comfort can be improved through architectural modifications, vegetation, and mechanical ventilation, informal settlements lack such interventions, making residents highly dependent on natural airflow. These areas' unplanned, high-density layout disrupts wind movement, leading to skimming flow—a condition where wind bypasses street level, resulting in stagnant air pockets that trap heat and pollutants.

Existing research on wind comfort has primarily focused on computational fluid dynamics (CFD), wind tunnel experiments, and urban microclimate models. However, it lacks an understanding of human responses to these conditions. While studies on thermal comfort examine how people mitigate heat stress, little research exists on behavioural adaptations to poor wind comfort in dense urban settlements.

This research aims to bridge that gap by investigating how residents of informal settlements experience and respond to stagnant air conditions. Three informal settlements where the street exhibits a skimming flow are selected. Further, wind temperature, speed, direction, humidity, etc., are collected at 20m intervals. Interviews are conducted with each resident on the street to gather their solutions/ adaptation strategies for the situation. By analysing human adaptation strategies, the study seeks to contribute to climatic resilience strategies for unplanned urban areas. Understanding the interplay between wind comfort and human behaviour will offer new perspectives on designing more breathable, thermally comfortable informal settlements, ultimately improving public health and social interaction in these spaces.

Key Words: Wind Comfort, Informal Settlements, Skimming Flow

Contents

Contents

01
Introduction

In many informal settlements, rising heat and poor wind circulation have become daily challenges that shape how people live, build, and interact with their surroundings. These microclimatic discomforts are intensified by dense street configurations, low-rise construction, and the absence of planning regulations — conditions that often lead to trapped heat and stagnant air. While much research has addressed thermal comfort through simulations or building performance metrics, less attention has been paid to how residents adapt to these conditions in practice, especially in the context of wind comfort.

Studies have explored thermal behaviour in urban canyons (Oke, 1987), the role of passive design in hot climates (Givoni, 1998), and airflow patterns in dense settlements (Johansson, 2006). However, these works largely remain data-driven or model-based. What is often missing is a grounded understanding of how people actually respond to wind and heat discomfort in their everyday environments — how they modify built form, use materials, and occupy space to create tolerable microclimates.

This study builds on that gap by focusing on lived adaptation. It examines how residents of informal settlements in Ahmedabad respond to wind discomfort under skimming flow conditions. Through field research in Bherampura, Vatva, and Vanjaravas, the work seeks to document and interpret the spatial, material, and behavioural tactics that people employ to manage heat and limited airflow — not as passive recipients of climate stress, but as active agents shaping their own comfort.

1.1 Why Human Adaptation?

Urban environmental research has long focused on modelling and measuring physical conditions through tools like Computational Fluid Dynamics (CFD). While these simulations provide valuable data on airflow and thermal performance, they often fail to account for how people actively respond to discomfort in dynamic, lived environments. These models are typically built on idealised assumptions — regular geometry, static materials, and fixed functions — which do not reflect the fluid, improvised ways that individuals interact with their built surroundings (Guan, 2010; He & Song, 2023).

In contrast, human adaptation reveals what models miss: how discomfort is perceived, negotiated, and managed in daily life. Understanding these behavioural and spatial adaptations is critical not only for capturing microclimatic reality but also for designing interventions that are socially acceptable, affordable, and responsive to local contexts. This is especially important in low-income, high-density environments, where climatic discomfort is often compounded by lack of access to cooling technologies or formal infrastructure (Brown & Walker, 2008).

Existing literature has explored various aspects of thermal and wind comfort through quantitative models. Oke (1987) introduced the concept of urban canyons, highlighting how geometry influences microclimate. Givoni (1998) and Szokolay (2004) advanced passive cooling strategies, while Rajagopalan et al. (2014) examined the influence of street morphology on pedestrian-level wind and heat stress. Emmanuel and Johansson (2006) noted the significance of urban ventilation in compact cities, while Giridharan et al. (2007) identified form-based cooling mechanisms in high-density areas.

These studies collectively provide a foundation for understanding and improving wind comfort in urban environments using computational models. They highlight the importance of using accurate simulation parameters, validation with experimental data, and considering various wind directions and design configurations to achieve the most favourable wind conditions (Blocken et al., 2012; Cao & Li, 2024; He et al., 2022; Lai et al., 2014). What is missing is an understanding of how individuals actively adapt to and shape their thermal environments. Understanding human adaptation would reveal behavioral resilience that models cannot account for (Brown & Walker, 2008).

Blocken, Bulkeley and Wan Jabarudin among others have recognised the need to incorporate human-centred approaches into wind comfort studies. Human adaptation and behaviour are crucial in how people perceive and respond to wind conditions. Some studies highlight the need to move beyond using traditional and static models to incorporate dynamic factors such as occupant behaviour and environmental control (Dear et al., 2013). They have suggested that on-site behaviour and participation numbers can be used to measure the sensitivity of humans and satisfaction with weather and climate conditions. Further, it suggests field observations of people on site who are engaged in tasks and interacting with the environment.

While simulation-based studies have greatly advanced our understanding of airflow and urban comfort, they often neglect the lived realities and adaptive agency of individuals navigating environmental stress. Recognising human adaptation as a key component of microclimatic response adds nuance to current approaches, moving beyond universal comfort thresholds toward more situated, culturally and socially embedded understandings. This lens is particularly valuable in contexts where formal infrastructure is lacking and adaptive behaviour becomes a critical everyday strategy. Therefore, studying how people respond to wind and heat discomfort through behaviour, spatial use, and low-tech interventions is essential for developing more inclusive, responsive, and grounded urban climate strategies.

1.2 Why Informal Settlements?

Informal settlements are typically self-built neighbourhoods where housing has been constructed without formal planning approval, access to legal tenure, or full provision of services (UN-Habitat, 2015). These areas often emerge from a mix of necessity, exclusion from the formal housing market, and urban migration. As a result, their form is shaped more by the daily realities of survival than by planning standards — producing irregular layouts, narrow streets, high densities, and limited access to infrastructure.

Such spatial and material conditions make informal settlements particularly vulnerable to the impacts of climate change. Residents often face intensified exposure to urban heat, poor ventilation, flooding, and inadequate waste or water systems. Studies have shown that low-income neighbourhoods experience higher surface temperatures and reduced wind movement due to dense building configurations and low reflectivity materials (Rao et al., 2017; Tran et al., 2013). The absence of formal drainage, tree cover, and ventilated design only compounds thermal discomfort, especially during summer months when the urban heat island effect is strongest.

At the urban scale, these settlements often form clusters within heat-prone areas, contributing to pockets of stagnant air and amplified thermal stress. At the street scale, factors such as narrow widths, low building heights, and high enclosure ratios lead to skimming flow conditions — where wind moves above roofline but not at the pedestrian level (Oke, 1987). This creates zones where heat is trapped, air is poorly circulated, and dust remains suspended.

Literature on informal settlements often centres on housing, services, or land tenure, with microclimate-related research focusing more on thermal comfort than on wind comfort (Johansson, 2006; Emmanuel

& Johansson, 2006). Very few studies engage directly with how communities in these settlements respond to limited airflow or stagnant heat.

This gap is important because informal settlements are expanding globally under worsening climate conditions. Urban heat stress and poor ventilation are not only discomforts — they are public health risks that disproportionately affect vulnerable populations (UN-Habitat, 2022). If design and policy continue to rely only on quantitative models or top-down interventions, they risk producing solutions that are climatically sound but socially ineffective or ignored.

Studying how people adapt — where they gather, how they shade or ventilate their homes, what low-cost materials they use — provides grounded insight into what works and why. These insights can inform more realistic, human-centred approaches to urban planning and design in dense, underserved areas.

This research therefore shifts the focus from what a settlement should look like, to how people make it work — revealing everyday climate-responsive practices that are already embedded in informal urban life.

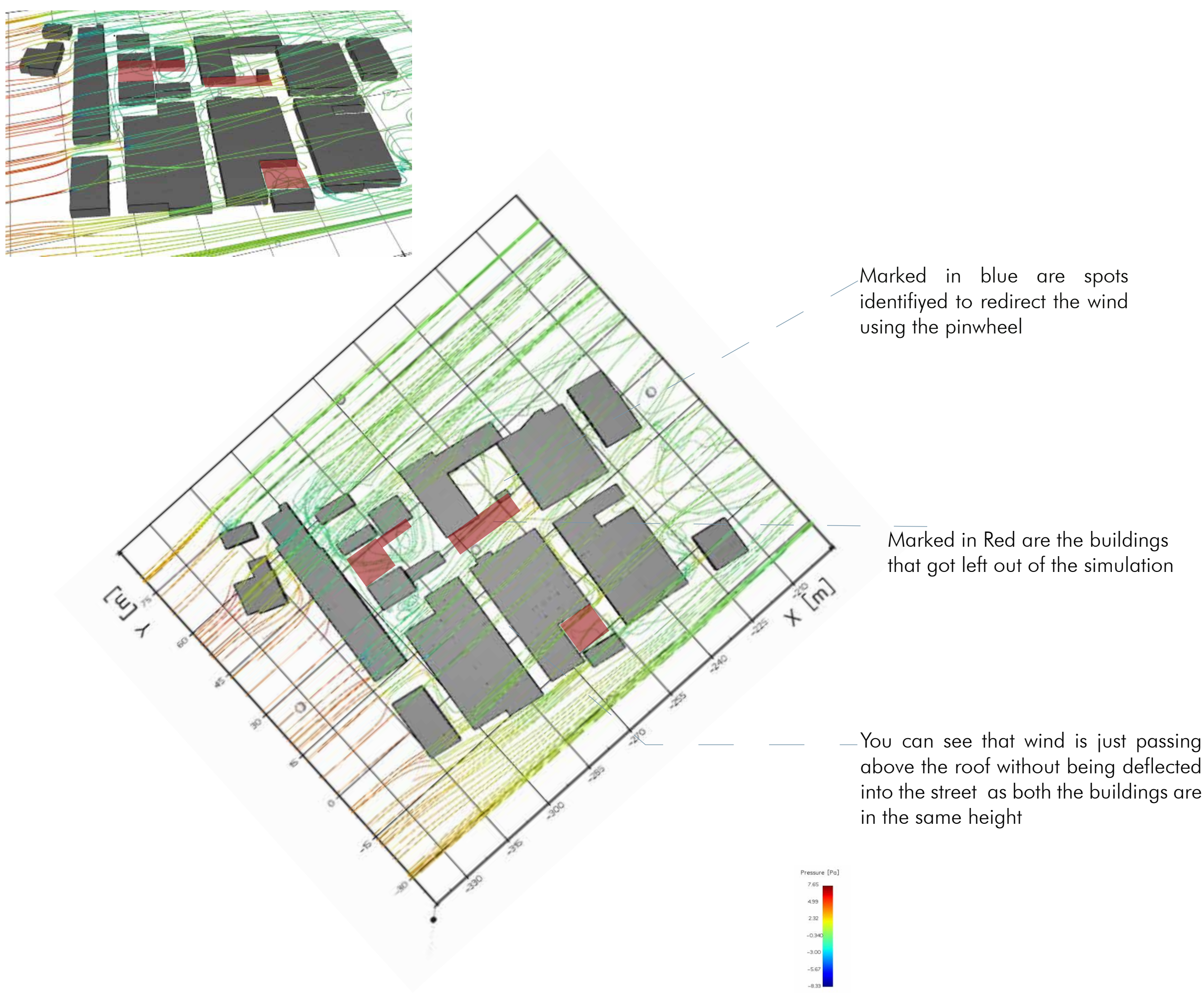


Figure 2.1: CFD simulation of street showing way wind is deflected in the streets and above the roof

02
Understanding Wind

What is wind? Why is it important for us to understand it? Wind is the movement of air from a high-pressure area to a low-pressure area. Multiple factors, including urban geometry and climate, influence its characteristics. Wind can have both thermal and mechanical effects on people. Thermally, wind influences comfort levels by affecting air temperature, radiation, and humidity. Hence, models for comfort are often unsuitable for outdoor use due to changing conditions (Erell et al., 2015).

Mechanically, steady winds can interfere with activities by affecting balance and increasing the effort needed for walking. Non-uniform winds, like those near building corners, can cause sudden changes in speed and direction, potentially leading to dangerous conditions. Gusts can also cause people to lose balance, depending on their speed, duration, and the individual's reaction time (Bottema, 1993).

Hence, it can be said that wind climate is closely related to urban geometry. Numerical simulations and experiments help understand the wind flow around buildings (Figure 2.1) (Zajic et al., 2011). High-rise buildings, streets and urban surroundings all play a role in shaping wind patterns. In the street, factors such as street orientation and the presence of trees can improve wind flow. Buildings act as obstacles, causing wind deflection, acceleration, and deceleration, as well as complex flow patterns within street canyons and around building corners.

Thus, the arrangement of the buildings also plays an important role in shaping the wind pattern. Narrow streets with irregular building faces can provide significant wind reductions. Conversely, aligned buildings can create wind tunnels, exacerbating wind discomfort. Gaps between buildings can also lead to an increase in wind speeds and turbulence (Bottema, 1993).

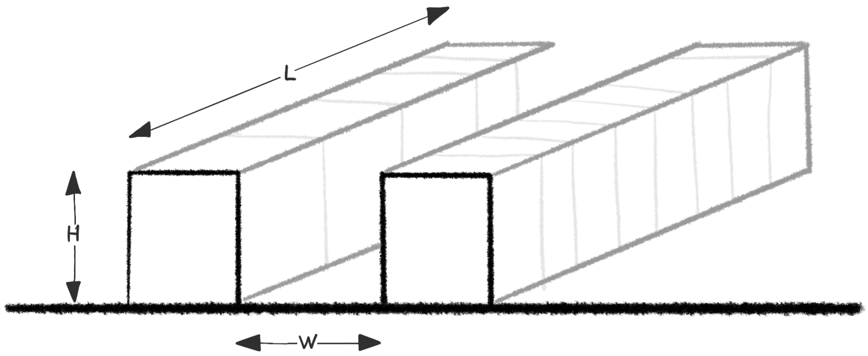


Figure 2.2: Shows a typical street canyon

The height, shape and space between the buildings determine the extent of the effects. Different flow regimes can be seen within urban street canyons, such as skimming flow, wake interface and isolated roughness flow regime.

2.1 Skimming Flow Regime

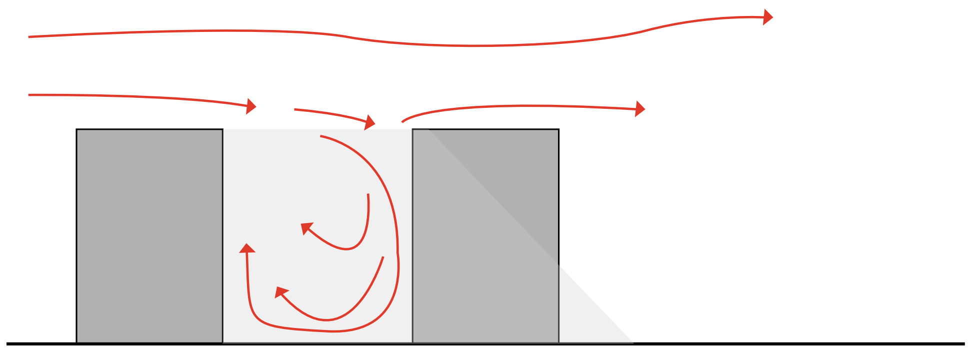


Figure 2.1.1: Shows the flow of wind during the skimming flow regime

In skimming flow, the air skims over the roofs of the buildings (Figure 2.1.1), with a minimal amount going down to the street. It typically develops when the ratio between the building height and street width is greater than 0.65 (Bottema, 1993; Krautheim & Pasel, 2014; Zajic et al., 2011; Erell et al., 2015). It is also characterised as a stable vortex that develops and remains separated from the airflow above the buildings. It typically occurs when the spacing between the buildings is relatively small, allowing a stable vortex to form within the gaps. This results in air mass being stagnated within the canopy layer as the vortex that is formed isolates the air within the street canyon. Therefore, pollutants tend to accumulate, leading to poor air quality at the pedestrian level. Furthermore, the limited air exchange leads to poor ventilation within the street canopy. This, in turn, increases the temperature and humidity levels, creating an uncomfortable microclimate (Erell et al., 2015; Bottema, 1993).

2.2 Isolated Roughness Flow Regime

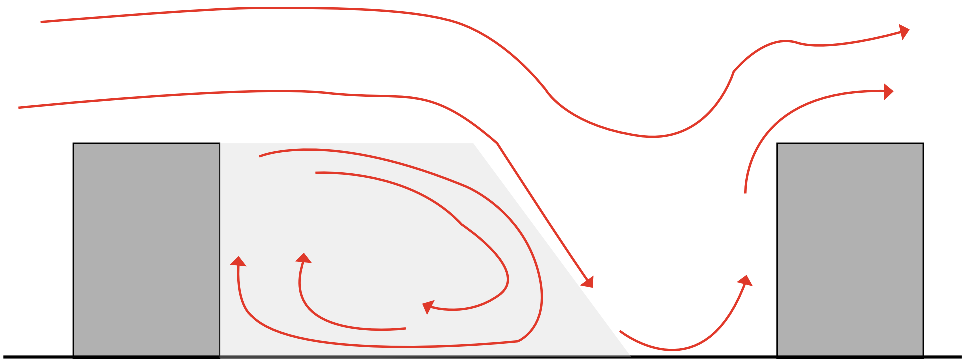


Figure 2.2.1: Shows the flow of wind between buildings during the Isolated Roughness flow regime

In this scenario, each building acts as an independent obstacle, where the airflow around one building is mainly independent of the airflow around the neighbouring buildings. This contrasts with skimming flow, where buildings are closely packed and wake interface flow, where the wakes interact but buildings are not fully isolated. It typically develops when the ratio between the building height and street width is between 0.3 and 0.5 (Erell et al., 2015; Bottema, 1993; Krautheim & Pasel, 2014; Zajic et al., 2011). As there are no neighbouring buildings to block or deflect the wind, it can lead to stronger ground-level wind conditions. Hence, the interaction of wind with individual buildings generates turbulence, which can affect pedestrian comfort and safety. Additionally, this flow regime promotes food air exchange and ventilation within the urban canopy, reducing the build-up of pollutants (Erell et al., 2015; Krautheim & Pasel, 2014; Nihar et al., 2023; Satterthwaite et al., 2020).

2.3 Wake Interface Flow Regime

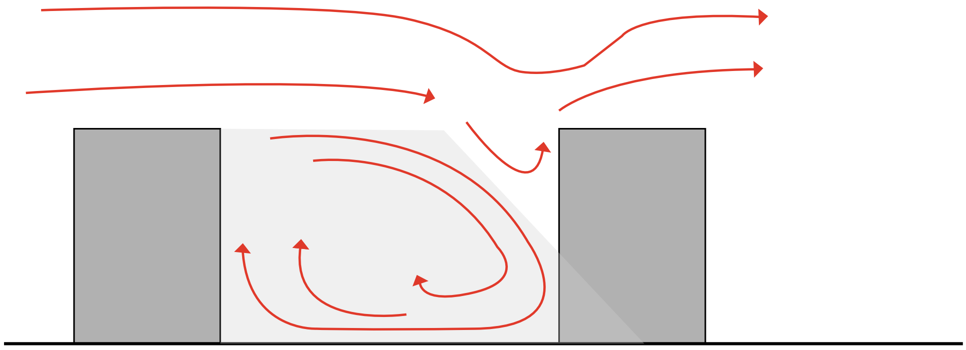


Figure 2.3.1: Shows the flow of wind between buildings during the Wake Interface flow regime

In this regime, the buildings are placed close enough to each other that their wakes interfaces with each other. It typically develops when the building height and street width ratio is less than 0.65 but greater than 0.5 (Bottema, 1993; Erell et al., 2015; Krautheim & Pasel, 2014). However, this is not enough for a stable vortex to form, leading to complex interactions and turbulence within the urban canopy. The wind flow is more dynamic than skimming flow, with greater air exchange between the street level and the airflow above the buildings. The increased turbulence and mixing help to disperse the pollutants, leading to better air quality at the pedestrian level than in the skimming flow. The enhanced air exchange improves ventilation and can help reduce temperature and humidity levels, creating a more comfortable microclimate. This flow involves complex interactions, making it difficult to predict wind conditions (Krautheim & Pasel, 2014; Nihar et al., 2023; Erell et al., 2015; Bottema, 1993; Blocken et al., 2012).

Understanding wind flow regimes is crucial to this study because they directly shape how air moves—or fails to move—at the pedestrian level in dense urban environments. Among these, skimming flow is particularly relevant to informal settlements, where low-rise, high-density configurations create conditions in which airflow passes over rooftops without adequately ventilating the street or ground-level spaces. This results in stagnant, heat-trapping microclimates, which are difficult to detect through traditional modelling alone but deeply influence daily comfort and spatial use.

By grounding the research in the logic of flow regimes, this study gains a framework to interpret residents' adaptations not just as arbitrary responses but as strategies that compensate for specific aerodynamic limitations. Practices like wetting surfaces, blocking or filtering wind with fabric, and creating shaded microzones can be seen as tactical responses to the absence of effective natural ventilation under skimming flow. Therefore, identifying and analysing these flow patterns is key to linking the physical environment with human behaviour—an essential step in proposing design strategies that are both climatically sound and socially grounded.

Figure 3.1: Satellite image showing Ahmedabad
Source: Google Earth

03
Context Study

Ahmedabad is the largest city in Gujarat, located in the northwest of India. Informal settlements are a significant aspect of the city's urban landscape, housing approximately 728,000 people. These settlements often lack proper insulation and cross-ventilation, making climatically comfortable shared open spaces particularly important, especially during the extreme summer temperatures that can reach over 50 degrees Celsius. Climate change exacerbates these conditions, making informal settlement communities particularly vulnerable to heat stress, heatstroke, and even death.

Ahmedabad's semi-arid climate significantly impacts the design and use of space in informal settlements. Many dwellings are constructed without insulation or cross-ventilation, making shared open spaces crucial for residents' comfort, especially during the hot summer months. The removal of trees in the city further intensifies the heat, increasing the risk of heat-related illnesses within these communities.

In some communities, like Vadhiyarivas in Ramapir No Tekro, houses become uninhabitable during the summer. As a result, residents rely on shared outdoor spaces, often shaded by large trees, for most of their activities year-round. These spaces provide a refuge from the extreme heat and offer a place for social interaction and daily life.

3.1 Environmental Parameters

Sun Path

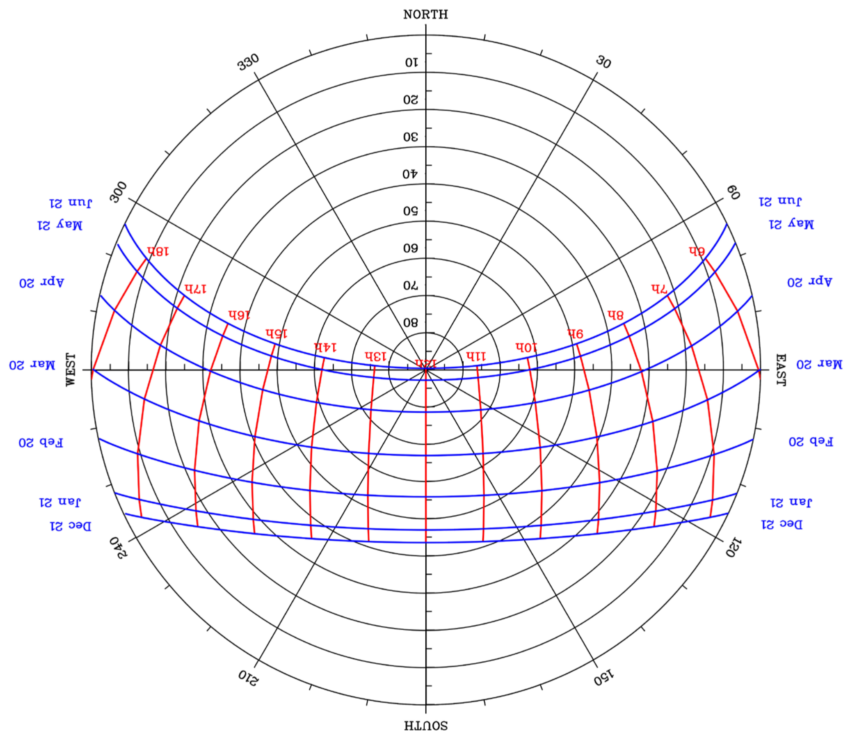


Figure 3.1.1: Sun path in Ahmedabad
Source: ISJDR

In the summer months (March to June), the sun rises in the northeast and sets in the northwest, following a high, steep arc. At its peak around midday (12:30–1:00 PM IST), the sun is nearly overhead, resulting in shorter shadows and intense direct solar radiation. This leads to high ground and air temperatures, especially under skimming flow conditions in narrow streets, where heat gets trapped.

In the winter months (November to February), the sun rises in the southeast and sets in the southwest, following a much lower arc across the sky. Midday sun angles are lower, casting longer shadows, which can improve thermal comfort in open and shaded spaces.

Temperature and Humidity

During the summer months (March to June), temperatures frequently soar above 42°C, with May often being the hottest. High daytime temperatures, combined with relatively low humidity levels (20–35%), create intensely dry and uncomfortable outdoor conditions. The Urban Heat Island (UHI) effect worsens this in dense, poorly ventilated areas where narrow streets and skimming flow trap heat at the ground level.

The monsoon season (late June to September) dramatically changes the microclimate. Temperatures drop slightly, ranging between 30°C and 38°C, but humidity levels rise sharply, often exceeding 70–80%. This increase in atmospheric moisture affects air density, slows down wind speeds in compact settlements, and increases the sensation of stuffiness and discomfort.

In the winter months (November to February), temperatures fall to a pleasant 12°C to 28°C, with humidity levels between 40–60%. Cooler temperatures improve thermal comfort, though morning and evening humidity can lead to dew formation in open areas.

These shifting temperature-humidity conditions directly influence residents' adaptive behaviours — from water-sprinkling practices to fabric-based shading — aiming to regulate heat, dust, and airflow at the street and household level.

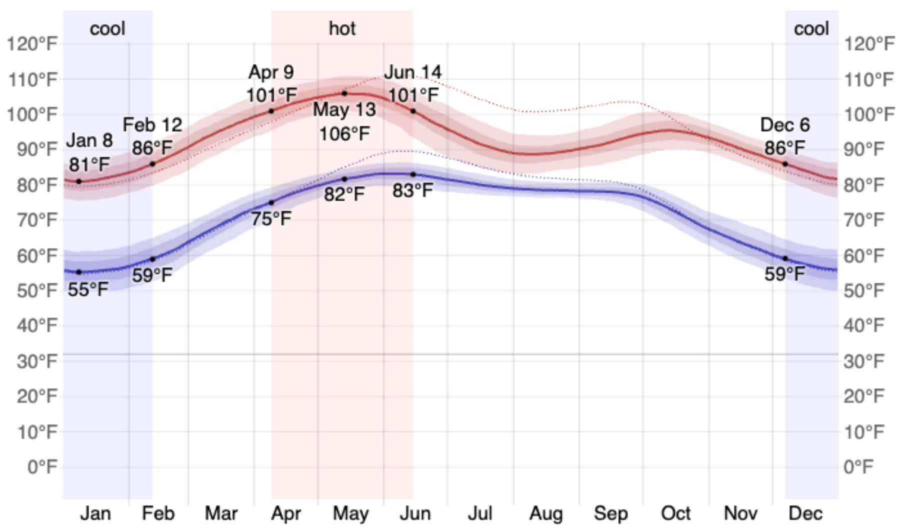


Figure 3.1.2: Average High and Low Temperatures in Ahmedabad
Source: Indian Meteorological Department

Wind Speed and Direction

Ahmedabad's wind patterns are highly seasonal, directly affecting ventilation, dust movement, and thermal comfort within the city. During the summer months (March to June), wind speeds are generally moderate, ranging between 5 to 12 km/h, predominantly blowing from the southwest due to the onset of pre-monsoon conditions (IMD, 2021). The arrival of the southwest monsoon from July to September increases both wind speed and variability, with gusts occasionally reaching 20 km/h, improving ventilation in otherwise dense and stagnant urban environments (Climate to Travel, n.d.). In the post-monsoon and winter months (October to February), wind speeds drop considerably, averaging between 3 to 8 km/h, with prevailing winds shifting towards the northeast (IMD, 2021).

These lower wind velocities, coupled with high enclosure ratios and narrow streets, critically affect ground-level ventilation, particularly in dense urban morphologies like those seen in informal settlements. At a global or regional scale, prevailing wind patterns are shaped by broader climatic systems, but their influence weakens dramatically as

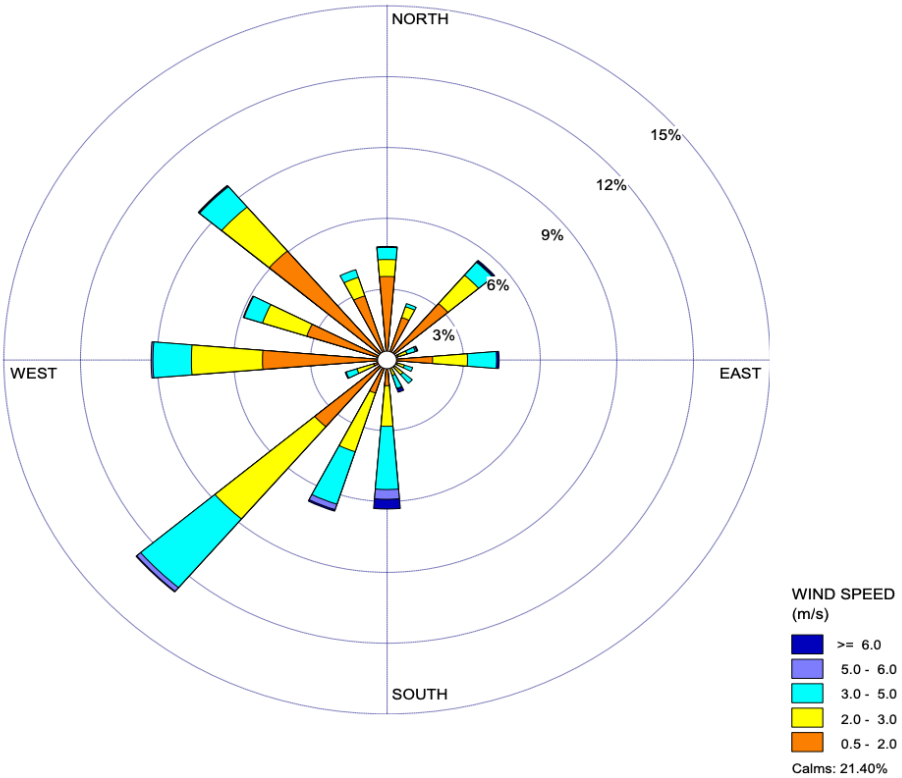


Figure 3.1.3: Wind Rose in Ahmedabad
Source: Indian Meteorological Department

they encounter the built environment of cities. At the urban scale, the morphology of buildings, street orientations, and enclosure levels begins to dictate how much of that wind is able to penetrate to the pedestrian level (Oke, 1987).

Within compact and irregular urban fabrics — especially those with low-rise and high-density forms — wind is increasingly obstructed. Studies have shown that urban canyons with certain height-to-width (H/W) ratios permit more effective channelling of wind at lower levels, while others can completely block or divert it (Rajagopalan et al., 2014). The skimming flow regime, which is most prevalent in narrow streets flanked by low buildings, further limits ventilation by causing wind to pass over rooftops with minimal mixing at street level. This leads to a layer of stagnant air, where heat builds up and dust remains suspended, producing conditions of high thermal and particulate discomfort.

In such microclimatic conditions, airflow is no longer a consistent environmental feature but a spatially and temporally variable phenomenon, dependent on fine-grain geometry. As a result, small shifts in street width, building height, or alignment can cause significant variations in wind comfort — often undetectable in broad simulations but deeply felt in everyday experience. This is where the logic of wind regimes becomes essential to this study: by analysing skimming flow and its effects, we can understand why certain discomforts persist, and how residents develop small-scale adaptations — such as adjusting openings, shading, or spraying water — to reclaim thermal relief in the absence of natural airflow.

04
Research Methodology

Given the layered nature of microclimatic discomfort and social adaptation, a mixed-methods approach was employed, combining quantitative environmental measurements with qualitative, community-based fieldwork. The chapter details the rationale behind site selection, data collection techniques such as wind speed and temperature logging, mapping protocols, and the development of an interactive card-based tool for participatory engagement. Emphasis is placed on how methods were adapted to suit the context of informal settlements, where conventional data collection can be challenged by mistrust, spatial complexity, and infrastructural limitations. This methodology aims to capture not just environmental variables, but the ways in which residents experience, interpret, and respond to them in their everyday lives.

4.1 Community-Based Engagement

To meaningfully study wind comfort and human adaptation in informal settlements, it was essential to go beyond conventional survey tools and adopt a participatory, trust-building approach. The residents' reluctance to speak openly — particularly due to fear of eviction or surveillance — made it clear that a more transparent, accessible, and engaging tool was necessary to both communicate the research intent and collect experiential data in an ethical and effective manner.

Why a Community-Based Tool?

Informal settlements are not only climatically vulnerable but also socially complex. Discussions around wind comfort, heat stress, or climate change can feel abstract or irrelevant to daily survival. As researchers, bridging that gap required a tool that could demystify climate concepts and simultaneously respect residents' experiences. Rather than viewing adaptation as a technical problem alone, this method treated it as a social and spatial behaviour shaped by lived experience.

Drawing inspiration from co-design practices and participatory climate communication tools (Van Aalst et al., 2008; Chambers, 2002), the decision was made to develop a set of interactive cards that would function as both an icebreaker and a co-learning device. The tool needed to be intuitive, visually simple, and based on conditions residents already experienced — rather than introducing unfamiliar language or top-down scenarios.

Making of the Cards

The content of the cards was informed by:

- On-site observations of microclimatic conditions (wind, heat, shade, dust)
- Initial exploratory interviews with residents
- Field notes categorising environmental stress and coping behaviours

These insights were distilled into three categories:

- Conditions (e.g., direct sunlight, blocked airflow, dusty environment)
- Impacts (e.g., feeling breathless, hot interiors, children falling sick)
- Strategies (e.g., wetting the ground, using curtains, building vents)

Each card was color-coded and illustrated using pictures to aid comprehension, especially for non-literate participants. The cards were laminated for durability and designed to be held, shuffled, and exchanged — reinforcing the idea of them as game pieces rather than survey forms.

How the Cards Were Used

Each session began with a brief introduction explaining the research in simple terms. Participants were handed five cards randomly. A Condition card was placed at the center, and players were asked to pick an Impact or Strategy card they felt was connected to it. They were encouraged to explain the link through discussion.

This game-like format helped:

- Spark spontaneous conversations among neighbours and family members
- Reveal nuanced, collective knowledge about environmental discomfort
- Build trust, by framing the discussion as informal and resident-led

Participants often consulted each other, debated choices, or related the cards to personal anecdotes. This informal structure created natural group dialogue, which led to richer, more grounded insights than a one-on-one interview could achieve alone.

This participatory tool not only helped elicit deep, context-rich responses but also validated the residents' role as co-analysts of their own environment. It demonstrated that community-based tools are not just ethical in sensitive urban contexts, but also methodologically powerful — especially when studying climate adaptation in environments where formal measurements cannot fully capture lived complexity.

Figure 4.1.1: One of the sessions where the cards were used with the residents as an icebreaker session.

4.2 Site Selection

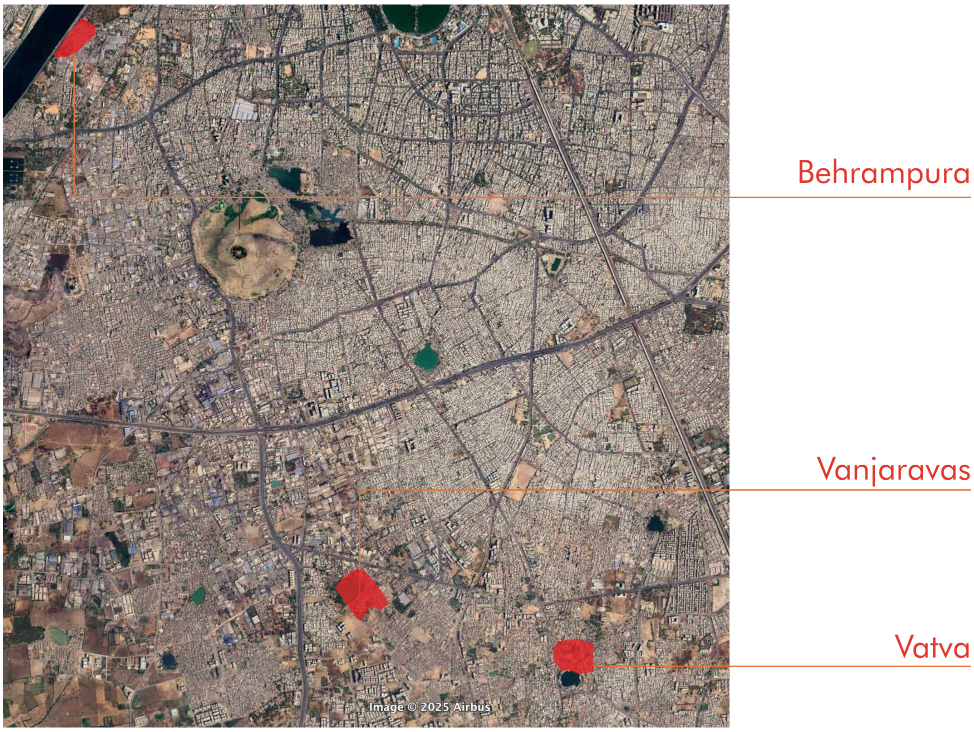


Figure 4.2.1: Satellite image showing the selected three sites
Source: Google Earth

As this study is being conducted in collaboration with SAATH, an NGO organisation in India, the settlements selected were limited to those under their operational jurisdiction. From this, Bherampura, Vatva and Vanjaravas were selected (Figure 4.2.1). Further, to select the streets, the building height and street width ratio were calculated for the streets under the three settlements. The streets that fulfilled the ratio criteria (greater than 0.65) were separated and analysed under their building heights, street length, street geometry, street orientation, etc. From this, the three streets were selected to gather the quantitative data.

With a length of 62 meters and a height-to-width ratio of 2 (3m building height / 1.5m street width), this street creates a comfortable microclimate. The closely built houses provide continuous shade throughout the day, significantly reducing exposure to harsh sunlight compared to the adjacent main road. As a result, the street remains noticeably cooler, especially during peak afternoon hours. The use of Kota stone paving further enhances thermal comfort by absorbing less heat and maintaining a relatively lower surface temperature. Together, these factors create a shaded, thermally pleasant, and pedestrian-friendly environment for local residents.

Figure 4.2.2: Satellite image of Bherampura with the selected street marked in orange
Source: Google Earth

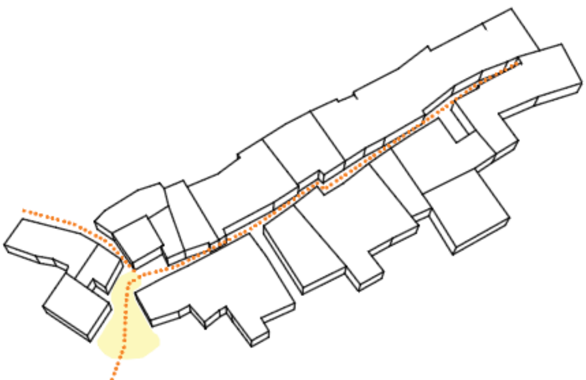


Figure 4.2.3: A 3-d model showing an aerial view of the street in Bherampura. With its access points marked.

This 70-meter-long street has a height-to-width ratio of 1.2 (3m building height / 2.5m street width). The street remained comfortable at both its ends and in the middle section when the ground was wetted, especially during hotter parts of the day. The relatively tall buildings on either side provided consistent shade, significantly reducing direct solar exposure. This allowed residents to comfortably occupy semi-open spaces like otlas (raised platforms at house entrances) even in the afternoon. The combination of shade, evaporative cooling from wetted ground surfaces, and active use of transitional spaces created a thermally pleasant, socially active environment.

Figure 4.2.4: Satellite image of Vatva with the selected street marked in orange
Source: Google Earth

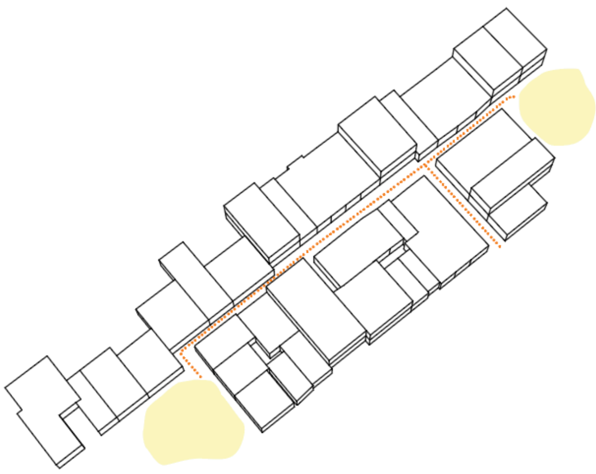


Figure 4.2.5: A 3-d model showing an aerial view of the street in Vatva. With its access points marked.

This 55-meter-long street has a height-to-width ratio of 0.8 (2.8m building height / 3.5m street width). The street remained uncomfortable throughout the day, with the exception of the intersection, where marginal airflow and open space slightly improved comfort. The low building heights offered little to no shade, leaving the street exposed to harsh, direct sunlight. Shaded areas were limited to covered verandahs and internal spaces, making the street itself largely unusable during peak hours. The absence of public transitional spaces and inadequate shading elements contributed to severe thermal discomfort, discouraging outdoor activity in this area.

Figure 4.2.6: Satellite image of Vanjaravas with the selected street marked in orange
Source: Google Earth

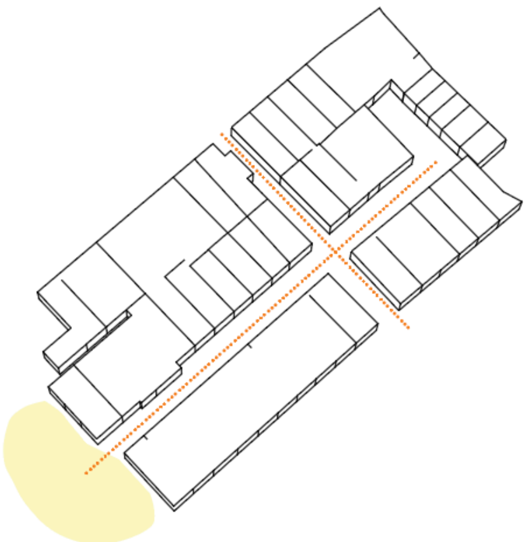


Figure 4.2.7: A 3-d model showing an aerial view of the street in Vanjaravas. With its access points marked.

4.3 Quantitative Data Collection

To understand the microclimatic conditions influencing wind comfort in informal settlements, environmental data was collected across three selected sites: Bherampura, Vatva, and Vanjaravas. Each site was chosen based on its morphology and confirmed presence of skimming flow conditions through initial spatial observations.

Parameters Measured

The quantitative data focused on four key environmental parameters:

Wind speed Wind direction Air temperature Relative humidity

These variables were selected to capture both thermal and ventilation characteristics of each street segment.

Instrumentation and Setup

Measurements were taken using a digital anemometer and thermometer-hygrometer, which were positioned at pedestrian height (approximately 1.5 meters above ground) to simulate the lived experience of airflow and temperature.

At each site, one representative street segment was selected that exhibited the spatial geometry consistent with skimming flow (low H/W ratio, enclosed sides). Along this segment, four points were marked at 20-meter intervals to allow consistent sampling across the length of the street.

Timing and Frequency

Data was recorded at each point between 12:00 PM and 1:00 PM daily for a continuous period of seven days. This time window was selected because it typically represents the hottest part of the day, when wind stagnation and heat stress are most acute and when adaptive strategies are most visibly employed by residents.

4.4 Limitations and Scope

The exploratory nature of this pilot study is limited to the three selected streets. Other streets in the area were observed, and interviews were conducted, but not mapped. The wind and temperature data were only collected between 12 PM and 1 PM, so it may not capture variations during other times of the day (e.g., early morning or evening breezes). Furthermore, the one-week period may not reflect seasonal changes (e.g., pre-monsoon or winter variations in wind patterns and humidity). Measuring at 20-meter intervals along one street per site may not fully capture the spatial heterogeneity of wind flow in the larger settlement. Hence, the collected data may not fully show the broader conditions of each neighbourhood.

The data from this study are context-specific to Bherampura, Vatva, and Vanjaravas, where each has its unique spatial morphology, building typologies, population density and microclimatic conditions. Hence, it can not be generalised to all informal settlements within Ahmedabad or outside. As each street has only one selected street as a site for analysis, it further narrows down the scope. Informal settlements are highly heterogeneous, even within a single location. The streets vary in width, orientation, building height, surface material and vegetation cover (Bottema, 1993; Erell et al., 2015; He et al., 2022; Hussainzad & Gou, 2024). As mentioned in other studies, these variables can cause variations in airflow patterns and thermal comfort that are not captured in a street-level limited survey. While this study provides insights into skimming flow and adaptation behaviours within a specific micro-context, the results can not be used to represent airflow conditions or adaptive strategies in settlements with different urban fabric, climatic zones, construction materials, socio-cultural and economic behaviours. Further studies need to examine a broader range of sites and incorporate larger datasets with diverse street morphologies and more comprehensive behavioural sampling.

While this study is limited in scale and duration, it offers critical insights into wind comfort and human adaptation in informal settlements — a subject that remains underexplored. By combining quantitative measurements with participatory methods, the study captures the nuanced ways in which residents experience and adapt to poor wind conditions under skimming flow. It sheds light on everyday, low-tech strategies that are often overlooked by simulation-heavy or policy-level research.

This study is useful because it bridges a key gap between climate modelling and lived experience, offering a framework that urban designers and policymakers can use to better understand and respond to microclimatic discomfort in dense, underserved environments. It demonstrates the potential of combining spatial analysis, environmental monitoring, and community engagement to inform climate-responsive, human-centric design strategies. Though site-specific, the methodology and insights can be adapted and scaled for other informal contexts across similar climatic zones.

05
Behaviour Under Skimming Flow

In environments where skimming flow dominates, wind bypasses the pedestrian level, leading to stagnant air and increased thermal discomfort. While the physical morphology of streets and buildings sets up the basic airflow condition, it is the way people use and modify these spaces that determines how tolerable or livable these conditions become. Hence, human behaviour plays a significant role in shaping microclimate at the street level (Oke, 1987; Johansson, 2006).

Previous studies have shown that even slight changes in spatial use, surface material, or street obstruction can meaningfully impact pedestrian-level wind speeds and thermal experience (Rajagopalan et al., 2014; Givoni, 1998). In informal settlements, where building form and space usage constantly evolve, this behaviour becomes both a response to and a modifier of environmental stress. For example, placing fabric curtains, storing water buckets, or creating shaded gathering spaces subtly alters the way air moves or stagnates at ground level. These are not passive adjustments, but active, spatial strategies that interact with the limitations of skimming flow to manage discomfort.

This chapter examines these behavioural responses across the three study sites, using both observational and interview data to understand how people adapt to low-ventilation conditions. By focusing on everyday choices, it explores how behavioural adaptation becomes an integral part of climate responsiveness in spatially constrained environments.

5.1 Water as a Relief

Residents in all three study sites actively use water as a microclimatic intervention to manage street-level discomfort during peak heat hours. This practice is not incidental — it is a deliberate response to low air movement and elevated dust in skimming flow conditions. Sprinkling water across unpaved or paved surfaces is a method rooted in evaporative cooling, where water absorbs heat from its surroundings to evaporate, thereby reducing surface temperature and increasing local humidity (Givoni, 1991; Meir et al., 1995). Even though the cooling effect is modest, it becomes significant in tightly enclosed streets where other forms of ventilation are minimal.

A widespread response to this is watering the streets, particularly in unpaved areas, where limited wind circulation leads to dust stagnation and increased airborne particulate matter. Residents use buckets of water to dampen the street surface (Figure 5.1.1.), which serves two wind-related functions:

- Reduces dust suspension in low-velocity, trapped air layers under skimming flow.
- Enhances evaporative cooling, slightly lowering the street's surface temperature and creating a marginally cooler microclimate that indirectly affects wind comfort.

Across all sites, this intervention was most commonly observed between 12 PM and 1 PM, aligning with the highest recorded temperatures and the lowest average wind speeds measured during fieldwork. According to the data collected, wind velocity at this time averaged below 0.3 m/s, consistent with stagnation typical of skimming flow conditions. Residents reported that wetting the surface at noon helped cool the area in the evening, suggesting a temporal permutation of benefits

— where daytime evaporation primes the surface for better thermal comfort when the street is more actively used later.

5.1.1: The image highlights the method of watering the entire street to keep the dust down and to cool the space down.

In narrow streets, however, this strategy has its drawbacks. Residents noted that increased humidity led to stuffy conditions when airflow was particularly constrained. Some responded by localizing the intervention — wetting only the area near their doorstep to create a cool buffer zone without affecting the rest of the street (Figure 5.1.3.). This adjustment was driven by experience rather than technical knowledge but reflects a nuanced understanding of how minimal wind, surface cooling, and humidity interact at micro scales.

Figure 5.1.2: The image shows how the streets are watered through daily chores. It also shows a kid accompanying their mother while doing her chores outside, resulting in the kid playing with the split over water-mudwater.

- Cools air near doorways without significantly increasing humidity in the stagnant, low-ventilation street environment.
- Creates a cool air barrier at entry points, counteracting the ingress of hot, dry air through doors.

Additionally, to optimise limited wind flow, residents clean their homes around noon, expelling dust into the open when the wind flow is least active and ensuring that when evening breezes return, they carry fresher, less dust-laden air into the homes.

In open spaces where residents work, buckets of water are strategically placed in the direction of prevailing afternoon breezes (Figure 5.1.4.), subtly cooling incoming airflow via evaporation. A few households also employ water-soaked fibre mats to capture dust particles, preventing them from being redistributed by the minimal ground-level winds present under skimming flow conditions. This aligns with Givoni (1991), who noted the value of simple evaporative and particulate control methods in semi-arid, low-ventilation environments.

Figure 5.1.3: The image highlights wetting the area next to their door to reduce the humidity entering into their house.

These adaptive practices demonstrate an intuitive, context-specific understanding of airflow behaviour and thermal comfort management in dense informal settlements. Residents creatively exploit micro-level interventions to modify the immediate environment within the constraints of skimming flow, subtly influencing wind comfort and air quality despite structurally poor ventilation.

Figure 5.1.4: The image highlights using a bucket of water while working or in gathering spaces in the direction of wind to increase comfort.

Limitations and Considerations:

Increased humidity caused by the evaporation of water in narrow streets with already constrained airflow, which can make the environment feel stuffy and reduce wind comfort (Rajagopalan et al., 2014).

Additionally, the cooling effects of watering are short-lived, as the streets quickly dry, and dust can be re-suspended in the air, negating the benefits of cooling (Givoni, 1991). Health risks also arise, as stagnant water can create muddy, slippery surfaces, posing hazards, especially for children, and may promote unsanitary conditions, such as mosquito breeding. Moreover, while watering reduces dust and slightly cools surfaces, it has little impact on altering the skimming flow or improving wind speed at pedestrian level, limiting its overall effect on airflow. Resource constraints, particularly water availability, are another challenge, as the practice depends on a steady supply of water, which may be scarce in informal settlements. Finally, the timing and selective application of water are crucial—watering only in front of homes or during peak heat hours can help manage humidity and thermal comfort. Integrating these practices with other passive cooling techniques, like shading or wind deflection, can mitigate the drawbacks and enhance their effectiveness.

5.2 Fabric as Deflectors and Filters

The next adaptation method identified in the settlements is the use of fabrics as wind deflectors and filters. The type, scale, and placement of these fabrics vary based on the household's needs and street conditions. Houses with larger openings typically use full-length curtains covering the entire frame from top to bottom and end to end (Figure 5.2.1.). These are secured with stones, hair clips, and other available objects. The function here is two-fold: they act as dust filters while also deflecting and reducing the speed of incoming wind. This aligns with studies that highlight how porous textile barriers can

Figure 5.2.1: The image highlights the usage of full curtains covering end to end. Tied down with the help of stones, hairclips,etc. Functioning purely like a filter and deflector for air.

reduce wind speed and improve airflow conditions by acting as semi-permeable surfaces (Hörteborn et al., 2023).

Another common variation involves leaving these curtains unconstrained, allowing them to move freely with the wind (Figure 5.2.2.). This helps slow down the airflow as it enters the house, making the internal environment more comfortable. Similar findings have been recorded in studies where flexible, permeable barriers modulate wind speed while maintaining air movement, creating a balance between ventilation and wind comfort (Hörteborn et al., 2023).

Figure 5.2.2: The image highlights the usage of curtains without any constraints. Letting it move freely as the wind comes in. It helps reduce the speed of the wind when it enters the house.

Where doors and windows are placed adjacent to each other, households often cover the window with fabric while keeping the door open (Figure 5.2.3.). This allows for partial deflection and filtering of air while maintaining visual access to the street — especially important for families whose children play outside. In some cases, both the door and window are covered with fabric, leaving an intentional opening at the top (Figure 5.2.4.). This setup lets filtered, slowed air enter while allowing excess air to escape upward, creating a controlled airflow pattern inside the home. These practices reflect an intuitive understanding of ventilation layering and pressure management, concepts that have been formally studied in relation to airflow patterns in narrow residential spaces (Givoni, 1991).

Figure 5.2.3: The image highlights closing the windows along with fabric; this is commonly done in houses with kids so they can keep an eye on them when playing outside.

Figure 5.2.4: On the left side, it highlights closing the door and window with fabric with an opening in the top. This lets the filtered air in while the opening on the top lets the air out. On the right side, fabric is used like a chajja to provide shade. Depending on its porosity, this also helps deflect and let through a certain amount of wind.

In relatively wider streets — though still under the influence of skimming flow — fabrics are sometimes used like temporary chajjas (projecting sunshades) to provide shade while modulating the wind (Figure 5.2.4.). The porosity of these fabrics influences how much air is allowed to pass through, balancing shade with airflow control. This aligns with research that demonstrates how textile screens of varied porosity can effectively reduce wind speeds while maintaining comfortable airflow in urban settings (Hörteborn et al., 2023).

Another observed strategy involves creating extensions in front of homes using vertical fabric barriers, typically laundry or cloth canopies (Figure 4.1.). These spaces act as transitional buffer zones, where the fabrics reduce wind speed before it enters the house, and simultaneously offer a semi-sheltered gathering space. Such semi-enclosed extensions are well-documented as effective passive cooling and wind-shielding measures in hot, dense urban areas (Brown & DeKay, 2014).

In many cases, wet fabrics are also strategically used. Clothes or curtains are dampened with water, allowing the breeze passing through to cool down through evaporation, while also helping capture

Figure 5.2.5: The image highlights having an extension in front of the houses, which acts as a barrier to prevent wind from entering. The space is usually covered with clothes to reduce the speed.

Figure 5.2.6: Highlights the usage of any clothes (laundry) as a barrier in front of the door. It reduces the wind's temperature when wet and acts as a barrier.

dust particles. This practice enhances thermal comfort and air quality within homes, combining evaporative cooling with dust control — a principle supported by passive cooling studies in hot-humid climates (Givoni, 1991). However, there are residents who deliberately avoid using curtains, citing safety concerns for their children, as unsecured curtains sometimes cause accidents when children play with them.

Limitations and Considerations:

These methods primarily function as wind deflectors and dust filters, but their effectiveness is influenced by the type of fabric and its permeability. Highly porous fabrics may not provide sufficient wind deflection, while denser fabrics could obstruct airflow, exacerbating the feeling of stuffiness, particularly in narrow spaces where ventilation is already limited (Rajagopalan et al., 2014). Additionally, fabric barriers can impede natural ventilation by blocking the free movement of air, especially in environments where air circulation is essential for thermal comfort (Givoni, 1991).

The durability of these strategies is another challenge. Fabric exposed to constant wind and dust can deteriorate quickly, requiring frequent replacement and increasing the long-term maintenance burden on residents (Givoni, 1991). This issue is compounded in areas where resources are limited, making it difficult for residents to maintain or replace the fabric regularly. Furthermore, fabric-based methods may present safety concerns for children, who could interact with or get entangled in the fabric. The varying wind conditions in informal settlements also limit the consistent effectiveness of fabric-based strategies, making them less reliable in certain weather conditions.

5.3 Built Modifications

The interviews reveal that residents have progressively adapted their construction strategies based on lived experiences of wind behaviour and structural performance. When spatial constraints limit window openings to only the entrance, residents introduced high vents near the roofline at the rear of their homes, particularly in ground-plus-one structures. These vents facilitate the stack effect, allowing hot air to rise and exit through the vent while drawing cooler air inward at lower levels, improving indoor air quality and thermal comfort (Givoni, 1998).

Residents initially attempted vertical extensions in areas experiencing frequent updrafts but soon observed that these winds damaged lightweight roofs and weakened adjoining walls. In response, they shifted towards horizontal expansion into available street space, preserving structural stability. However, this strategy reduced street width, intensifying skimming flow conditions — where airflow moves above rooflines with little penetration to street level, increasing stagnation and thermal discomfort (Oke, 1987).

To further manage airflow while ensuring privacy and security, homes typically feature small windows or jali (perforated) windows. These limit the direct entry of dust-laden or harsh winds while allowing for diffuse light and controlled ventilation. Jaali designs, rooted in Indian architecture, break up high-speed winds, reduce pressure differences between indoor and outdoor spaces, and promote a gentler, filtered breeze — especially valuable in hot-dry climates like Ahmedabad's (Meir et al., 1995). Smaller window sizes also reduce heat gain during peak afternoon hours while maintaining cross-ventilation through carefully positioned openings.

Additionally, to combat monsoon-driven lateral winds that dislodged roof elements, residents began leaving small gaps at the junction of the roof and wall to relieve wind pressure. While this reduced structural stress, it inadvertently created entry points for pests and insects, highlighting the trade-offs between wind comfort and domestic hygiene.

Limitations and Considerations:

While contextually effective, the construction strategies adopted in these settlements — such as roof-level vents, small and jali windows, horizontal expansion, and roof-wall gaps — come with important limitations and considerations. The performance of vents and small openings highly depends on the presence and consistency of external wind flows. In areas dominated by skimming flow, like those studied by Oke (1987), air movement at the pedestrian level is minimal, limiting the effectiveness of these measures in providing thermal relief indoors. Although beneficial in reducing glare, dust, and wind pressure, small or jali windows can restrict ventilation rates, especially during humid or wind-stagnant periods (Givoni, 1998). Horizontal expansion, though structurally preferable in high-wind contexts, leads to narrow street canyons, reducing air circulation and increasing surface temperatures. The practice of leaving roof-wall gaps allows warm air to escape but compromises hygiene by inviting pests, especially during monsoons.

Additionally, these strategies are highly context-specific, reliant on available materials, spatial constraints, and socio-economic conditions. Care must be taken to balance wind comfort with safety, privacy, and indoor air quality. Any future improvements or adaptations must consider these physical, social, and environmental trade-offs inherent to informal settlement living.

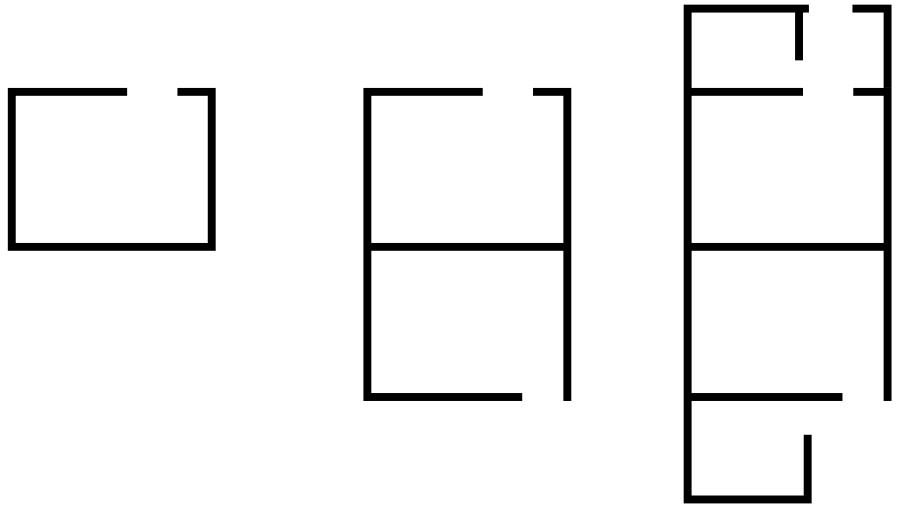


Figure 5.3.1: While constructing extensions to houses, residents prefer increasing them horizontally rather than vertically.

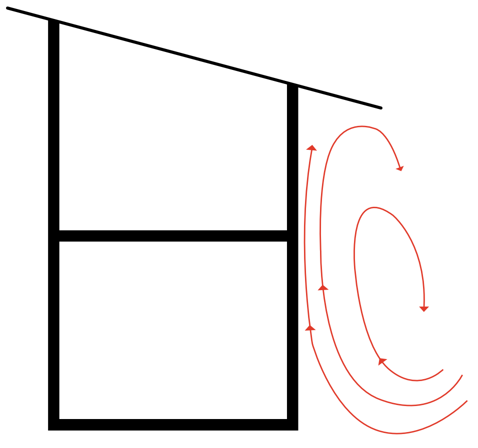


Figure 5.3.2: If they were to increase it vertically, their roof does not last long due to the upwinds.

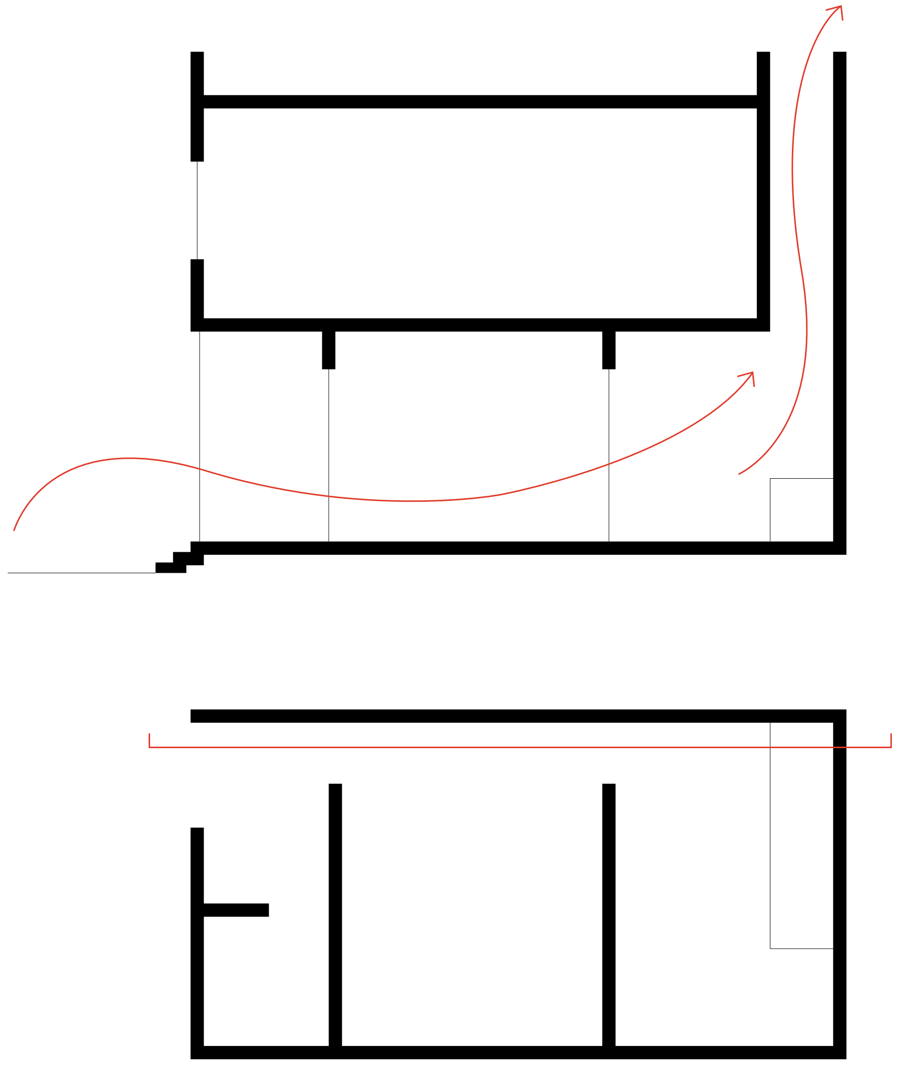


Figure 5.3.3: A double-height vent at the end of the house to let the air go out. Commonly done in G+1 houses that have no provision to have windows.

Berampura					
Location	**Air Temperature**	**Wind Speed m/s**	**Humidity**	**Humidity**	**Temperature**
	Average	**Average**		**(from weather station)**	
Day 1					**06/03/2025**
A	33.25	0.1	20	21%	35
B	34.1	0.8	19	21%	35
C	33.6	0	22	21%	35
D	34.75	0.1	18	21%	35
Day 2					**07/03/2025**
A	35.65	0.15	23	24%	38
B	33.25	0.6	20	24%	38
C	34.95	0.1	26	24%	38
D	38.6	0.4	20	24%	38
Day 3					**09/03/2025**
A	36.15	0	22.5	24%	39
B	37.65	1	21	24%	39
C	36.4	0.4	25	24%	39
D	39.2	0.1	19	24%	39
Day 4					**11/03/2025**
A	40.05	0.1	24	29%	41
B	39.9	0.55	26	29%	41
C	38.6	0.1	32	29%	41
D	40.95	0.65	28	29%	41
Day 5					**12/03/2025.**
A	39.5	0.2	24.5	31%	41
B	40.75	1.05	28	31%	41
C	39.6	0	30	31%	41
D	41.8	0.35	27.8	31%	41

Table 1: Recorded Wind Speed, Temperature, and Humidity Levels – Bherampura

06
Spatial Street Usage Under Skimming Flow

Understanding how people use and occupy street space is essential when studying human adaptation to microclimatic discomfort. In informal settlements, where public and private boundaries often blur, streets are not merely transit corridors but multifunctional spaces for rest, work, play, and social interaction. This layered use of space directly influences — and is influenced by — environmental conditions like heat and airflow. Studying spatial usage allows us to see how residents strategically position themselves in relation to shade, breeze, or shelter, and how these choices reflect a deep, often intuitive understanding of the microclimate. Moreover, the ways in which people modify, extend, or claim street space — through fabric shading, household extensions, or daily routines — actively shape how wind moves, stagnates, or cools in dense urban morphologies. Analysing spatial behaviour, therefore, is not just about documenting where people are, but how they adaptively choreograph their environment to manage discomfort, making it a vital lens for understanding wind comfort under skimming flow conditions.

Vatva					
Location	**Air Temperature**	**Wind Speed m/s**	**Humidity**	**Humidity**	**Temperature**
	Average	**Average**		**(from weather station)**	
Day 1					**19/03/2025**
A	38.7	0.25	13.4	19	36
B	38.65	0.3	18.3	19	36
C	39.9	0.25	20.4	19	36
D	38.2	0.75	14.6	19	36
Day 2				**21/03/2025**	
A	37.15	0.1	18.3	35	35
B	38.75	0	20.8	35	35
C	38.75	0.7	22.5	35	35
D	38.15	1.1	18.2	35	35
Day 3					**22/03/2025**
A	37.4	0.15	17.5	25	36
B	37.6	0.25	22.5	25	36
C	40.55	0.75	25.3	25	36
D	37.4	0.8	16.9	25	36
Day 4					**23/03/2025**
A	39.5	0	18.7	22	37
B	39.7	0.35	23	22	37
C	41	1.15	27.4	22	37
D	38.4	0.85	16.4	22	37
Day 5					**12/03/2025**
A	40.5	0.2	21	29%	35
B	40.5	0.35	24.4	29%	35
C	39.6	0.45	28	29%	35
D	39.2	0.65	20.7	29%	35

Table 2: Recorded Wind Speed, Temperature, and Humidity Levels – Vatva

Vanjaravas					
Location	Air Temperature	Wind Speed m/s	Humidity	Humidity	Temperature
	Average	Average		(from weather station)	
Day 1					19/03/2025
A	38.85	0.5	16.9	19	36
B	39.5	1	16.2	19	36
C	39.7	0.25	17.5	19	36
D	39.25	0	17	19	36
Day 2					21/03/2025
A	40	0	17.4	35	35
B	39.15	0.8	18.3	35	35
C	40.8	0.15	18.9	35	35
D	40.25	0.1	19.4	35	35
Day 3					22/03/2025
A	41.75	0.15	16.4	25	36
B	40.45	1.25	17.5	25	36
C	42.25	0	17.9	25	36
D	40.25	0.2	18.3	25	36
Day 4					23/03/2025
A	43	0.25	14.3	22	37
B	39.9	1	14.9	22	37
C	41.6	0.05	16.8	22	37
D	41.15	0	17.4	22	37
Day 5					12/03/2025
A	41.65	0.3	17.9	29%	35
B	40.15	0.8	17.4	29%	35
C	40.55	0.25	19.2	29%	35
D	39.6	0.05	18.4	29%	35

Table 2: Recorded Wind Speed, Temperature, and Humidity Levels – Vanjaravas

6.1 Usage in Bherampura

The recorded environmental data provides quantitative backing to the spatial behaviour observed on site. Among the four zones measured, Zone B—the central street segment—recorded the highest average wind speed at 0.4 m/s, and the lowest average temperature at 38.1°C. However, unlike the peripheral zones, Zone B is typically not associated with active daytime street use beyond people sitting outside their homes. The primary zones of activity are Zone C and Zone D, where residents engage in daily work, particularly garlic peeling, which involves long hours of sitting and social interaction.

Zone D, which serves as the entrance to the street, recorded a moderate wind speed of 0.32 m/s and an average temperature of 39.1°C, slightly higher than Zone B, but still within a tolerable range for extended occupation. Humidity levels in both active zones (C and D) were consistent at around 48–49%, supporting the use of midday watering and Kota stone paving to maintain thermal comfort. These adaptations appear to effectively manage heat retention and dust suppression, contributing to the preference for Zones C and D despite slightly warmer conditions.

Zone A, located at the dead-end of the street, recorded a slightly higher temperature (39.3°C) and lower wind speed (0.28 m/s). It showed minimal activity during the day, reflecting both its spatial isolation and relatively less favourable environmental conditions. As a cul-de-sac, it lacks through movement and airflow, further contributing to its low usage. The overall analysis shows that while Zone B performs best in quantitative terms, Zones C and D are more socially and economically active. This highlights the nuance that thermal comfort alone does not determine spatial use—activity is influenced by habit, visibility, and collective familiarity as much as environmental metrics.

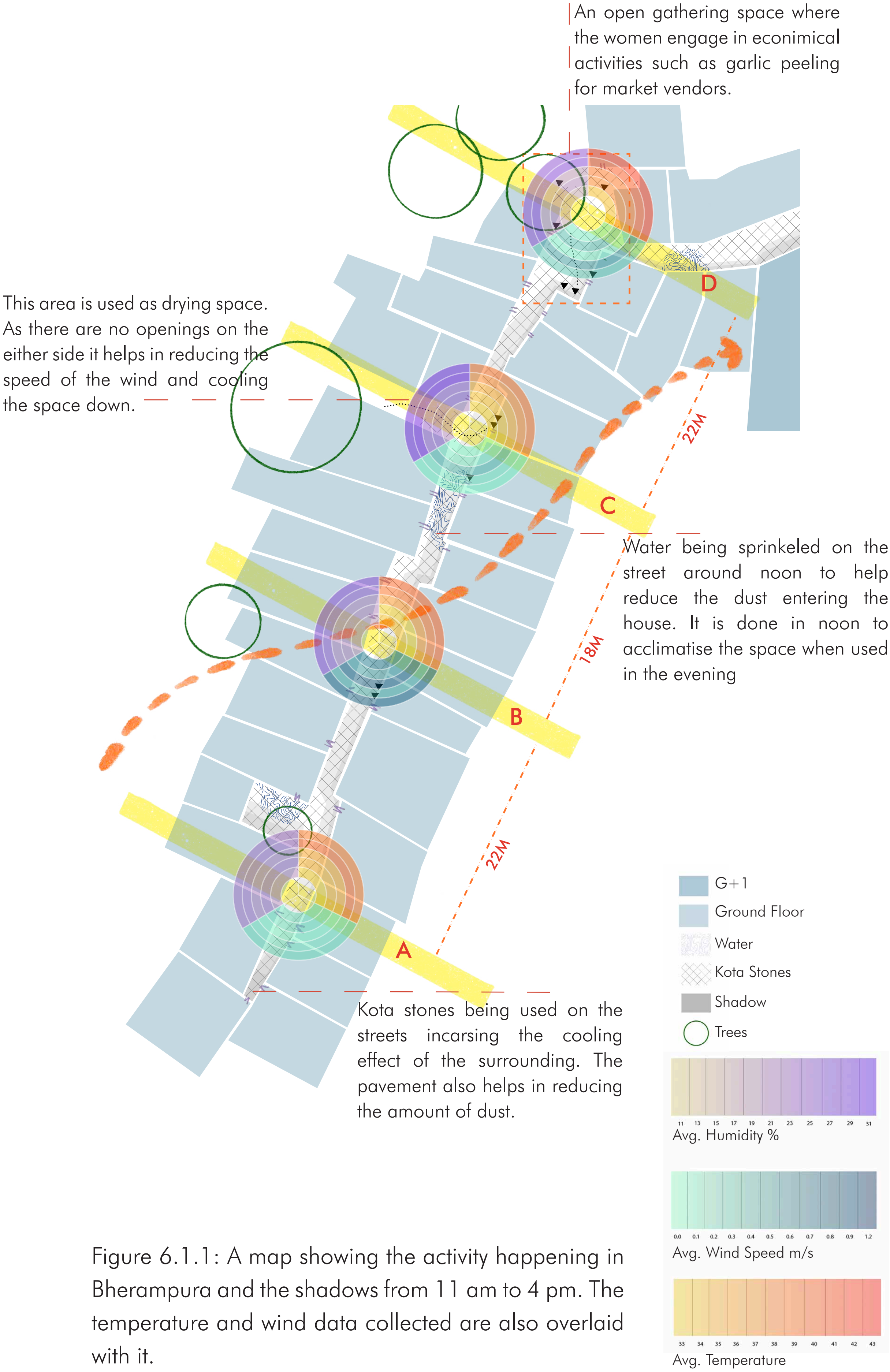


Figure 6.1.1: A map showing the activity happening in Bherampura and the shadows from 11 am to 4 pm. The temperature and wind data collected are also overlaid with it.

6.2 Usage in Vatva

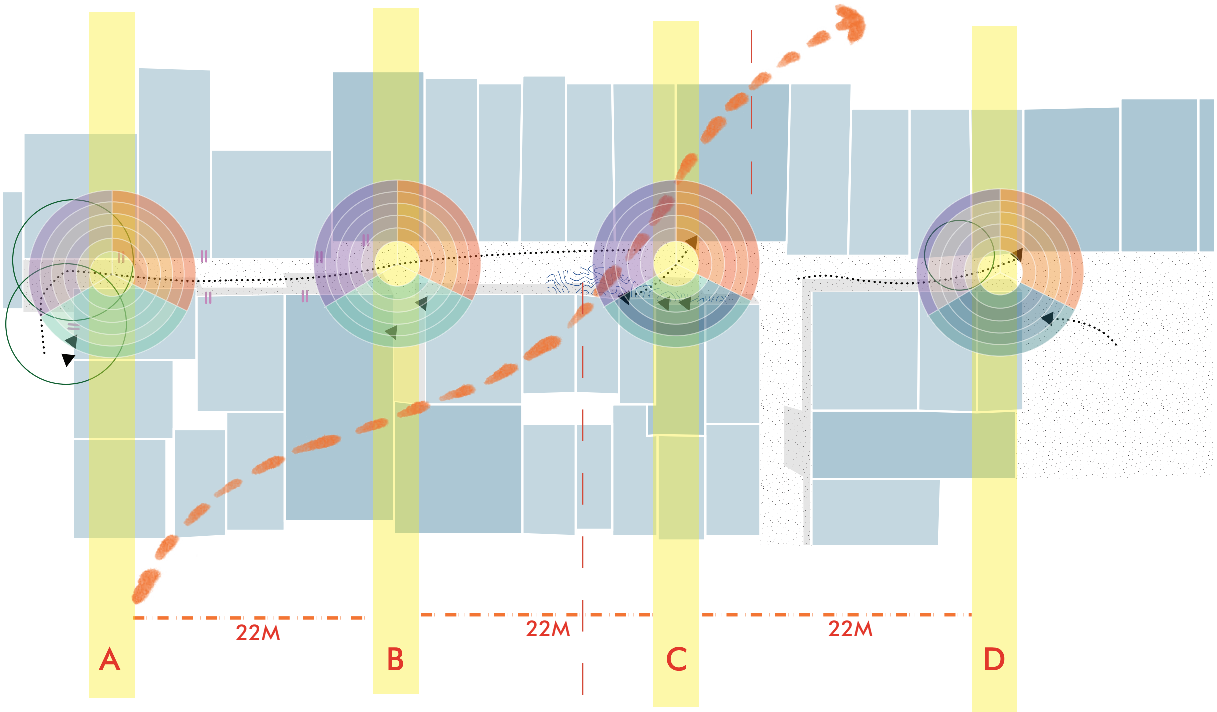
At the Vatva site, spatial behavior patterns around wind comfort show both similarities and notable differences when compared to Bherampura. Unlike Bherampura, where shaded areas dominate and pedestrian comfort is achieved primarily through reduced solar exposure, in Vatva, residents tend to gather in spaces where the temperature is relatively lower due to consistent airflow. Observations show that wherever there is a constant flow of wind, temperature and humidity levels are better regulated, making these zones significantly more comfortable during the hotter parts of the day.

This reliance on airflow rather than just shade has also influenced architectural adaptations. Many of the houses in Vatva feature double-height vents or high-level openings. These vents facilitate the stack effect — allowing hot air to rise and escape, while drawing in cooler air from lower openings (Givoni, 1998; Szokolay, 2004). The integration of these vertical ventilation features aligns with passive design strategies documented in hot-dry climates, where promoting vertical air movement is critical to achieving indoor comfort in dense urban environments (Oke, 1987).

Additionally, the habit of occupying semi-open thresholds like otlas, especially near breezeways, highlights a local adaptation to the microclimatic conditions created by informal street canyons. As Rajagopalan et al. (2014) point out, even slight variations in street geometry and building height can significantly impact wind speed and thermal comfort at pedestrian level in compact urban forms.

Thus, in Vatva, wind-driven comfort plays a more active role in determining spatial use than simply the presence of shade. This distinguishes it from Bherampura, where shading and pavement material (e.g., Kota stone) are the dominant factors in thermal regulation.

The double storey houses in this site have a double height vent that helps in air circulation within the house in the absence of a window.



Water being sprinkeled on the street around noon to help reduce the dust entering the house. It is done in noon to acclimatise the space when used in the evening

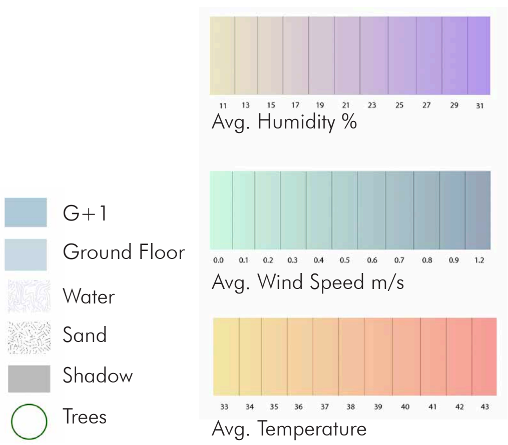


Figure 6.2.1: A map showing the activity happening in Vatva and the shadows from 11 am to 4 pm. The temperature and wind data collected are also overlaid with it.

In Vatva, environmental data closely aligns with how residents adapt spatially to thermal and ventilation conditions. Zone B recorded the most favourable conditions, with an average temperature of 38.4°C and wind speed of 0.3 m/s, which matches its consistent daytime use. The presence of double-height vents in houses adjacent to this zone contributes to effective vertical air escape, improving internal airflow through stack ventilation. These vents, commonly found in ground-plus-one structures, are passive strategies for thermal regulation and were often paired with the use of porous jali windows to control dust and light without fully blocking airflow.

Zone D, located near the more open part of the street, recorded similar environmental conditions—38.7°C temperature and 0.29 m/s wind speed. The slightly increased air movement here correlates with reduced built obstructions and more shaded thresholds. This allowed residents to use otlas—elevated, shaded platforms at door fronts—as social and functional extensions of their homes during hot periods. Humidity in these zones remained manageable (around 45–51%), allowing for regular use of evaporative cooling practices, such as wetting surfaces near thresholds.

While Zones A and C were less actively used, they still exhibited occasional activity due to the modular use of public-private edges. Residents often selected these spaces based on the timing of airflow or the availability of shade rather than strict climatic performance. This occupancy pattern suggests that microclimatic regulation is not the sole determinant of street use—habit, visibility from indoors, and surveillance over children also shaped where and when people gathered.

6.3 Usage in Vanjaravas

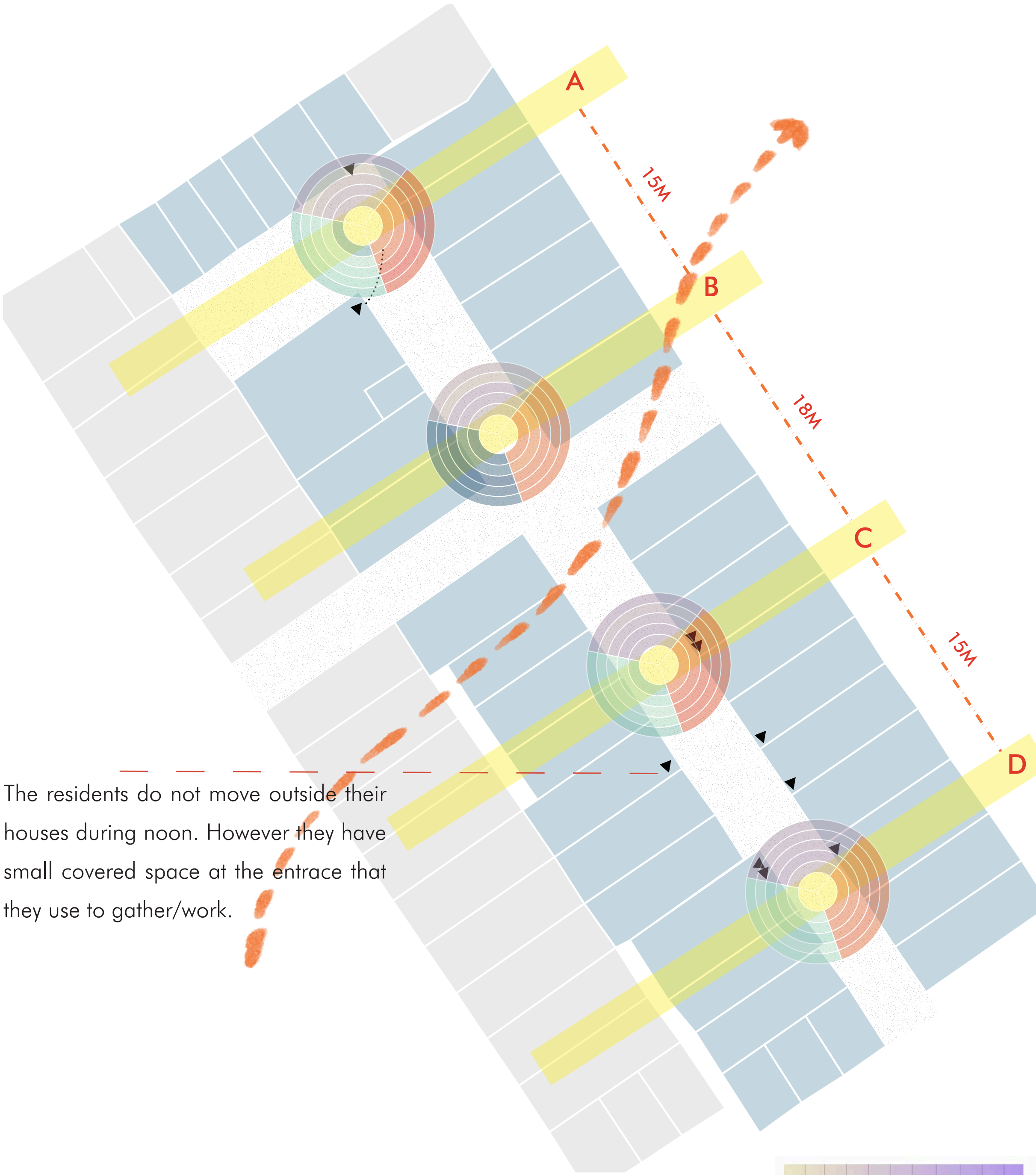
At the Vanjaravas site, observations reveal a distinct difference compared to both Bherampura and Vatva. Despite the presence of adequate wind movement, residents still experience high temperatures and elevated humidity levels, and the environment remains thermally uncomfortable. Even when air circulation is present, the temperature regulation is poor, suggesting that mere airflow is insufficient to offset heat buildup in this context.

A key contributing factor is the street geometry: the building height averages around 2.8 meters, while the street width is significantly wider (around 3.5 meters). This places the street morphology at the broader edge of the skimming flow category, where wind flows predominantly above roof level but does not effectively penetrate or cool the pedestrian zone (Oke, 1987). As a result, the streets remain exposed to direct solar radiation with limited shading, and the available wind at ground level is not sufficient to disperse heat effectively.

Unlike in Vatva or Bherampura, residents in Vanjaravas tend not to gather in the open street spaces. Instead, social activity concentrates in closed verandah spaces at the front of houses. These semi-open thresholds are protected using fabric curtains and enhanced through water-sprinkling, leveraging evaporative cooling at a very localized scale. This adaptation strategy helps mitigate the intense heat in small personal zones, though it does not significantly improve comfort across the broader street environment.

This pattern aligns with findings in urban climatology, where studies show that street canyons with low building heights and wide geometries under skimming flow suffer from poor thermal comfort even when nominal airflow exists (Johansson, 2006). Moreover, interventions such as wetting pavements and using fabric screens echo low-tech, passive cooling methods historically employed in hot-arid regions to create habitable microclimates (Givoni, 1998).

Thus, Vanjaravas highlights the limits of relying solely on natural airflow for cooling and shows how micro-scale adaptations become critical in wide, exposed street environments.



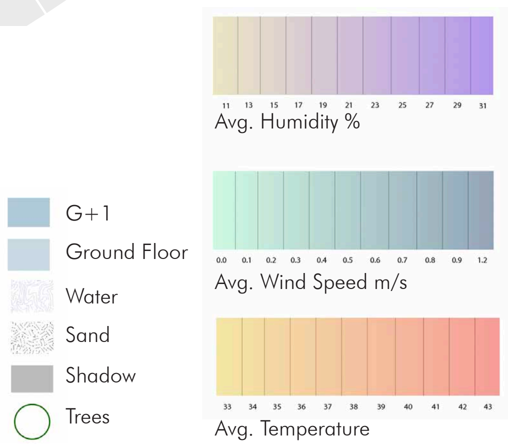


Figure 6.3.1: A map showing the activity happening in Vatva and the shadows from 11 am to 4 pm. The temperature and wind data collected are also overlaid with it.

Vanjaravas presents a spatial typology where favourable wind speed measurements do not result in user comfort or active street use. Despite Zone B registering a moderate wind speed of 0.28 m/s, it also recorded the highest average temperature at 41.2°C and humidity levels peaking at 58%, creating a thermally uncomfortable microclimate. This is a result of the mismatched height-to-width ratio of the street, which is approximately 0.8, making the street too wide (3.5 m) for its 2.8 m high buildings to create any meaningful shading or funnel wind effectively to pedestrian level.

As a consequence, airflow likely skimmed the rooftop level, leaving the ground zone exposed to solar radiation and stagnation. Residents adapted by retreating into closed verandahs, where temporary shade and evaporative strategies like water-soaked cloths or wet curtain screens were used. These adaptations were often not shared at the community level, making them highly localised and effective only in microdomains such as a single threshold or doorway.

The intersections of the street showed slightly more activity due to shade from cross-street built forms and marginal air circulation. However, even in these areas, people avoided prolonged exposure during peak heat hours. Interview data revealed that families used water buckets near breezeways not just for cooling but as a sensory cue for airflow.

Condition / Character	Observed Response / Strategy	Mechanism Type	Site(s)	Effectiveness / Notes
High heat and skimming flow (low wind movement at ground level)	Watering streets and doorfronts, cleaning around noon	Water-based	Behrampura, Vatva	Lowers ground temp, but increases humidity — effective locally
High heat + dusty wind	Wetting curtains, hanging wet mats, dipping mats in water	Fabric + Water	Behrampura, Vanjaravas	Slows hot winds, captures dust, temporary cooling
No openings except entrance	Adding high-level vents, leaving gaps at roof-wall junction	Building modification	Vatva, Behrampura	Enhances stack ventilation, but may invite pests
Strong updrafts / monsoon winds	Avoid vertical extension, expand horizontally	Building modification	Behrampura	Prevents structural damage, worsens skimming flow
Limited shaded public space	Use of otlas and shaded spots, creating semi-open transitional areas	Space-use adaptation	Vatva	Utilized during shaded hours only, informal thermal refuge
Narrow streets + poor air movement	Hanging clothes as makeshift barriers, using fabrics as chhajja	Fabric-based	Behrampura, Vanjaravas	Deflects wind, controls sunlight, reduces exposure
Peak noon heat	Closing windows, doors progressively, sprinkling water at entry points	Mixed	All three sites	Creates localized microclimate control

07
Construction Guidelines

In rapidly urbanising contexts — particularly in informal settlements — building form evolves not through top-down regulation but through iterative, need-based construction. Conventional building codes, often derived from formal urban models, fail to reflect the lived realities of dense, low-income environments. These codes prioritise structural stability, fire safety, or sanitation, but rarely account for everyday thermal discomfort, wind stagnation, or the adaptive strategies people already employ to manage them (Davis, 2006; UN-Habitat, 2014).

As climate change intensifies urban heat and disrupts natural ventilation, it is increasingly important that construction guidelines offer flexibility and contextual responsiveness, especially in dense neighbourhoods that fall outside the formal planning framework. Scholars have argued for a shift toward climate-responsive design, which includes integrating passive ventilation, adaptive shading, and participatory construction practices into both new and retrofitted environments (Givoni, 1998; Meir et al., 1995).

This chapter proposes practical construction strategies drawn from both field observations and literature to enhance wind comfort at the street and dwelling scale. These guidelines are not prescriptive codes but adaptable principles that aim to improve microclimatic performance while respecting the autonomy and resource constraints of residents.

7.1 Guidelines Emerging from This Study

Based on fieldwork conducted in Bherampura, Vatva, and Vanjaravas, this study identifies a series of resident-led adaptations that can be formalised into construction principles for improving wind comfort in dense environments dominated by skimming flow. These guidelines are derived from environmental measurements, behavioural observations, and interviews, offering practical strategies rooted in lived experience:

Encourage vertical ventilation through high-level vents

Residents in ground-plus-one homes often create openings facing the roofline to allow hot air to escape. These stack-effect driven vents should be standardised as affordable features in new construction.

Screens or mesh should be included to block pests and debris while maintaining airflow.

Incorporate flexible façade treatments using fabric or porous shading

Curtains and jalis (perforated masonry) are widely used to filter air and control dust and wind exposure. Guidelines can include modular façade elements that allow residents to adjust exposure throughout the day.

Design semi-open thresholds (otlas, verandahs) with airflow in mind

In all three sites, people gather in these spaces during the hottest hours. Ensuring these are shaded, oriented to catch afternoon breezes, and open to minor evaporation (e.g., via water use) can improve usability.

Promote site-wide cooling strategies like collective street watering

While localized water use near thresholds offers minimal relief, coordinated efforts in wider street sections significantly reduce dust and perceived heat. Guidelines could suggest community-level practices and materials for water-retaining pavements.

Preserve and regulate H/W ratios where possible

Street sections with H/W ratios between 1.5 and 2 had the most moderated conditions. Guidelines should discourage excessive horizontal encroachment and encourage staggered massing to break flow stagnation.

These recommendations emerge directly from observed spatial practices, thermal behaviour, and resident interviews, offering a grounded alternative to abstract thermal indices or rigid building codes.

7.2 Guidelines from Existing Research

Existing research supports and expands on the practical findings of this study, emphasising passive, adaptive, and community-led strategies as essential to wind comfort and microclimatic resilience in dense urban areas:

Shading and Semi-Permeable Boundaries

Meir, Etzion, and Faiman (1995) demonstrated that using permeable barriers for shade significantly enhances airflow while reducing solar heat gain in arid housing environments. Curtains and jalis thus serve dual purposes of dust control and thermal moderation.

Orientation and Ventilated Form

Givoni (1998) argued for optimising building orientation and introducing narrow forms and ventilated rooflines to increase cross ventilation and mitigate overheating in warm climates.

Low-Cost, Flexible Retrofitting

UN-Habitat (2014) recommends modular retrofits, such as roof vents and breathable facades, that can be adapted without large-scale demolition, particularly in informal settlements.

Community-Led Construction and Co-Design

Both Davis (2006) and Chambers (2002) stress that durable, relevant change in informal areas arises from within the community. Participatory strategies lead to higher success rates in climate resilience by aligning intervention with local behaviour and knowledge.

These supporting studies reinforce this project's call for flexible, human-centric construction guidelines that integrate passive strategies with spatial behaviour, especially in areas where formal policy tools fall short.

08
Conclusion

This study demonstrates that even in the most spatially constrained and climatically challenging conditions, people actively engage with their environment to adapt, resist, and reshape discomfort. In the context of skimming flow—a wind regime typically overlooked in everyday design practices—residents of informal settlements in Ahmedabad deploy a rich range of adaptive strategies: from building modifications and water-based cooling to fabric deflection and dynamic spatial use. These are not simply reactions but intentional, experience-driven practices that address the shortcomings of formal planning and environmental modelling.

By combining environmental data with community-based methods, this research foregrounds lived knowledge as a critical component of climate adaptation. It shows that while simulations can tell us where discomfort lies, only people's practices reveal how it is negotiated. These insights are valuable not just academically, but for architects, planners, and policymakers working toward equitable climate resilience. Incorporating human behaviour and micro-level adaptations into urban guidelines—particularly for settlements often excluded from regulatory frameworks—can lead to more grounded, flexible, and responsive interventions.

Future strategies for urban resilience must move beyond technocratic models to embrace the everyday intelligence embedded in informal urban life. This is where climate adaptation is already happening—quietly, locally, and effectively. Recognising, validating, and learning from it is essential for shaping cities that are not only breathable, but just.

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List of Figures

Source: Google Earth

Figure 4.2.2: Satellite image of Bherampura with the selected street marked in orange
Source: Google Earth

Figure 4.2.3: A 3-d model showing an aerial view of the street in Bherampura. With its access points marked.

Figure 4.2.4: Satellite image of Vatva with the selected street marked in orange
Source: Google Earth

Figure 4.2.5: A 3-d model showing an aerial view of the street in Vatva. With its access points marked.

Figure 4.2.6: Satellite image of Vanjaravas with the selected street marked in orange
Source: Google Earth

Figure 4.2.7: A 3-d model showing an aerial view of the street in Vanjaravas. With its access points marked.

5.1.1: The image highlights the method of watering the entire street to keep the dust down and to cool the space down.

Figure 5.1.2: The image shows how the streets are watered through daily chores. It also shows a kid accompanying their mother while doing her chores outside, resulting in the kid playing with the split over water-mudwater.

Figure 5.1.3: The image highlights wetting the area next to their door to reduce the humidity entering into their house.

Figure 5.1.4: The image highlights using a bucket of water while working or in gathering spaces in the direction of wind to increase comfort.

Figure 5.2.1: The image highlights the usage of full curtains covering end to end. Tied down with the help of stones, hairclips,etc. Functioning purely like a filter and deflector for air.

Figure 5.2.2: The image highlights the usage of curtains without any constraints. Letting it move freely as the wind comes in. It helps reduce the speed of the wind when it enters the house.

Figure 5.2.3: The image highlights closing the windows along with fabric; this is commonly done in houses with kids so they can keep an eye on them when playing outside.

Figure 5.2.4: On the left side, it highlights closing the door and window with fabric with an opening in the top. This lets the filtered air in while the opening on the top lets the air out. On the right side, fabric is used like a chajja to provide shade. Depending on its porosity, this also helps deflect and let through a certain amount of wind.

Figure 5.2.5: The image highlights having an extension in front of the houses, which acts as a barrier to prevent wind from entering. The space is usually covered with clothes to reduce the speed.

Figure 5.2.6: Highlights the usage of any clothes (laundry) as a barrier in front of the door. It reduces the wind's temperature when wet and acts as a barrier.

Figure 5.3.1: While constructing extensions to houses, residents prefer increasing them horizontally rather than vertically.

Figure 5.3.2: If they were to increase it vertically, their roof does not last long due to the upwinds.

Figure 5.3.3: A double-height vent at the end of the house to let the air go out. Commonly done in G+1 houses that have no provision to have windows.

Figure 6.1.1: A map showing the activity happening in Bherampura and the shadows from 11 am to 4 pm. The temperature and wind data collected are also overlaid with it.

Figure 6.2.1: A map showing the activity happening in Vatva and the shadows from 11 am to 4 pm. The temperature and wind data collected are also overlaid with it.

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Table 1: Recorded Wind Speed, Temperature, and Humidity Levels – Bherampura

Table 2: Recorded Wind Speed, Temperature, and Humidity Levels – Vatva

Table 2: Recorded Wind Speed, Temperature, and Humidity Levels – Vanjaravas

Apendix

Questionnaire

- How long have you been living here?
- Where are you from?
- How many people are in your house?
- What does your day look like?
- What is the hottest month that you have experienced?
- Which space feels better to work in, inside or outside?
- Why so? What makes the other space discomforting?
- When you are outside (in front of their house/street), do you get any wind?
- Which side does it come from?
- Do you get ventilation inside your house?
- If you don't get any ventilation, then what do you do?
- Is there anything you can do to make the outside cooler during summer?
- If you do, how long does it last?
- How do you prevent dust from entering the house?
- Do you make any dietary changes for the summer? (More liquids, fewer solids?)
- Do you sleep outside during the summer?
- If they are someone who works outside
- What time do you work outside?
- What work do you do? (What kind of income do you generate?)
- How many people work together?
- Where do you work, and why that particular place?
- Do you get enough wind?

Interview 1

Introduction to the People in Site
Location: Meenakshi Bhen's House
Number: 5 - 6 People
Method: Using Cards

The everyone leaves home by 10 max. Then we start anyother work we have, I stich fabrics and sell them, she has a saree business, she sorts the waste and there are a few ladies who peel garlic and sell them.

So all your activities are indoor? Does it get hot and suffocating inside?

Ofcourse it does, but what else can we do? Most of the people who live here have A/Cs right now so we use that if needed but the bill comes a lot.

When we get a breeze it is filled with dust so we strarted using a thin cloth like a curtain but tight in the bottom so that it doesnt move. If I am working in that room then I sprinkle water on it sometimes.

I dip the door mat into a bucket of water for 10 to 15 mintues and the put it in the entrance. The mat is really thick and is make out of some fiber I think it is coconut coir cause it is really rough. If i keep it out around 12 it dries up by 2 or 3. I feel like it attracts all the dust to it, cleans the feet also better.

Whatever we do with water we do it at between 12 to 3. If we do it after that it becomes suffocating in the evening.

Like she said there is dust and the wind is also hot when it comes so I prefer shutting all doors and windows.

When do you close and open them?

I close the windows around 11am and then the doors around 12pm after cleaning the house.

Interview 2

Kids affecting lifestyle
Location: Opposite Gulshan Bhen’s House
Number: 2 People
Method: Oral Questionnaire

She was washing her utensiles outside the house when we approached her.

I have 5 people living here, 2 kids, one has gone to the school the other one is here. May usually is the hotest month here, other houses have A/C but we don’t. We have to manage with the fan only.

The food gets spoilt quickly during summer so we try to cook freshly but things like roti and all we make it once in the morning, thats all.

I dont have any curtains beause my kid play with it by putting his head on it and has falled down a lot. Sprinkle water infront of my house increses humidity and he tends to play with it.

Interview 3

Life Working on the Street

Location: Bherampura Point A
Number: 3 People
Method: Oral Questionnaire

We get garlic from the wholesale vendor at 6 in the morning. We are expected to finish peeling them by 10, but we cant do it by then and usually goes on until 1pm max.

We only sit here in this open space and work cause there one shade or another when we work and we get nice wind from that opening. After 11 the wind we get is also hot so we just keep water bukets in that direction.

Is the water used only for this or does it have anyother uses?

When we give back the peeled garlic to the vendors they will need it in the exact weight that they droped it off in so we soak the chilka in the water to increse it weight.

Interview 4

The Elder of the Neighbourhood
Location: Gulshan Bhen's House
Number: 1 People
Method: Oral Questionnaire

I have been living here for almost 25 years. Seen this street change people move in and out and the riverfront project being constructed.

The street used to we wide enough for bullock cart to go through. First we tried building a first floor but the roof did not last at all. Later the walls also started failing because of the upwind from the riverside. So we started exanding horizontally reducing the width of the street.

Now a days it is really hot year round, only the winter four months is nice. A lot of the roof fly off right before the first showers, thats when the wind is really hard. To stop the roofs from lifting we started making some small gap in the juction between the wall and roof sheet.

Talking about the roof, monkeys are also really a problem we have to keep changing the roof cause they damage them.

In some community meeting 3 years back I was told that using kota stones will reduce indoor temperature, so when we were extending the house we had them put for the entire house. So now the inside is so much better.

We tried using khus khus but it started molding our windows (wodden) so we stopped using it. It also started feeling stuffy if we used it a lot in the peak of summer.

Before the riverfront construction the back of this house was filled with trees so we used to get nice wind without the heat. We also used to sleep outside then.

If there is any problem in the community people generally aproach me, going to offices for documents or if anyone is in any trouble. I try schedulling all this work anytime but 11 to 3 cause its really hot that i cant step out.

Interview 5

Double Story Modification

Location: VATVA
Number: 3 People
Method: Oral Questionnaire

We used to live behind the Vatva Lake, after saving enough to construct a proper house we shifted here about 20 years back. Almost everyon in this lane has a similar story.

You dont thave any windows apart from the ones in the entrace, how do you get ventilation?

The first floor was recently constructed (3-4 years back), we have left a double height open so the air just goes through all the rooms and up the vent. Because it place above the stove, the smoke also goes up without us having to do anything. The three houses that have first floor have this system for ventilation.

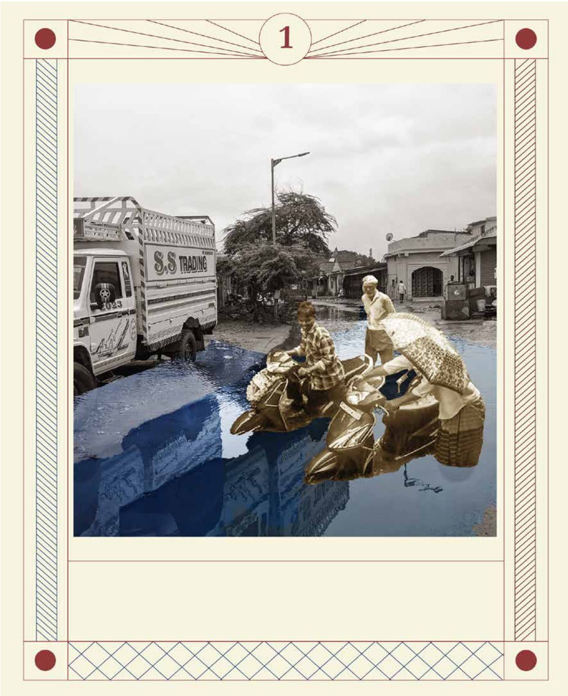
We clean the house around noon, it helps keep the dust down also makes the evening pleasant.

If you see in front of our house we (and the people opposite to us) have just sprinkeled water. This part of the cleaning we do, because it keeps the dust and sand down we open up all our doors and windows until it drys.

We used to dry clothes inside our house but it started chipping our paint away.

Cards

Condition



जल भराव

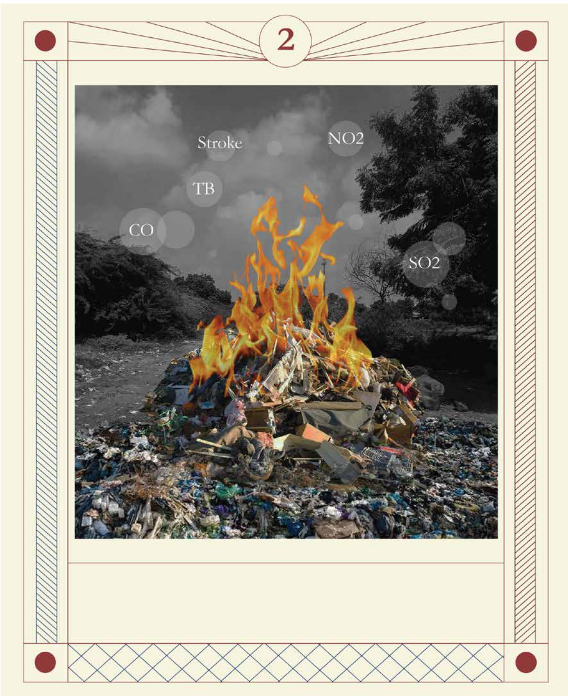
मानसून के दौरान जल-जमाव का कारण खराब जल निकासी, अभेद्य सतहें, तथा रसायनों के अत्यधिक उपयोग से मिट्टी का क्षरण, जिससे जल अवशोषण और निस्पंदन कम हो जाता है।

પાણીનો ભરાવો

ચોમાસા દરમિયાન પાણી ભરાવાનું કારણ ખરાબ ડ્રેનેજ, અભેદ્ય સપાટીઓ અને રસાયણોના વધુ પડતા ઉપયોગથી માટીનું ધોવાણ થાય છે, જેના કારણે પાણીનું શોષણ અને ગાળણક્રિયામાં ઘટાડો થાય છે.

WATER-LOGGING

Water-logging during monsoons is because of poor drainage, impermeable surfaces, and soil degradation from chemical overuse, reducing water absorption and filtration.



कचरा जलाना

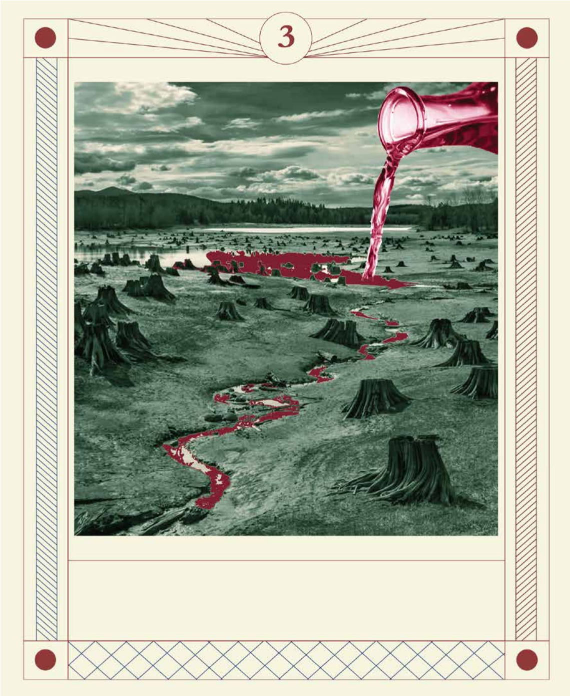
कचरा जलाने से हानिकारक रसायन निकलते हैं, जिससे स्वास्थ्य और पर्यावरण को खतरा पैदा होता है।

કચરો બાળવો

કચરો બાળવાથી હાનિકારક રસાયણો નીકળે છે, જે સ્વાસ્થ્ય અને પર્યાવરણીય જોખમો ઉભા કરે છે.

WASTE BURNING

Burning garbage releases harmful chemicals, posing health and environmental risks.



जहरीला रिसाव

उद्योग अनौपचारिक बस्तियों में विषाक्त अपशिष्ट फेंकते हैं, जिससे निवासियों को नुकसान पहुंचता है तथा मिट्टी और जल प्रदूषित होते हैं।

ઝેરી ઝરણું

ઉદ્યોગો ઝેરી કચરો અનૌપચારિક વસાહતોમાં ફેંકે છે, જેનાથી રહેવાસીઓને નુકસાન થાય છે અને માટી અને પાણી પ્રદૂષિત થાય છે.

POISONOUS SEEPAGE

Industries dump toxic waste in informal settlements, harming residents and polluting soil and water.

जल प्रदूषण

खराब अपशिष्ट प्रबंधन के कारण जल निकायों में कचरा डाला जाता है, जिससे जल प्रदूषित होता है

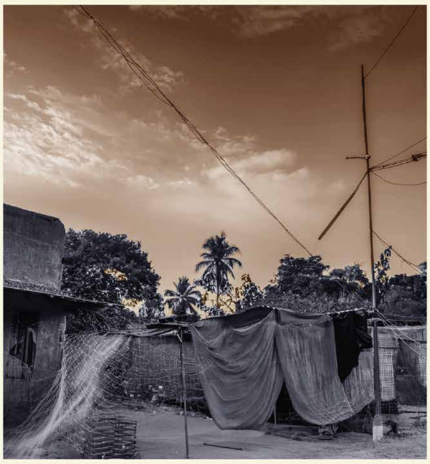
જળ પ્રદૂષણ

ખરાબ કચરા વ્યવસ્થાપનને કારણે જળાશયોમાં કચરો ફેંકાય છે, જેનાથી પાણી દૂષિત થાય છે

WATER POLLUTION

Poor waste management leads to dumping in water bodies, contaminating water

6



हवा का तापमान

हवा का तापमान इस बात को प्रभावित करता है कि लोग बाहर कितना सहज महसूस करते हैं, गर्म मौसम में ठंडक पहुंचाता है और ठंडे इलाकों में ठंड कम करता है, आर्द्रता भी एक भूमिका निभाती है

પવનનું તાપમાન

પવનનું તાપમાન લોકોને બહાર કેટલું આરામદાયક લાગે છે તેની અસર કરે છે, ગરમ હવામાનમાં ઠંડક આપે છે અને ઠંડા વિસ્તારોમાં ઠંડી ઘટાડે છે, ભેજ પણ ભૂમિકા ભજવે છે

WIND TEMPERATURE

Wind temperature affects how comfortable people feel outside, cooling in hot weather and reducing cold in chilly areas, humidity also plays a role

5

निर्माण सामग्री

टिन जैसी हल्की सामग्री गर्मी और हवा की अशांति को बढ़ाती है, जबकि कंक्रीट जैसी सघन सामग्री वायु प्रवाह को अवरुद्ध करती है, जिससे वेंटिलेशन और आराम प्रभावित होता है।

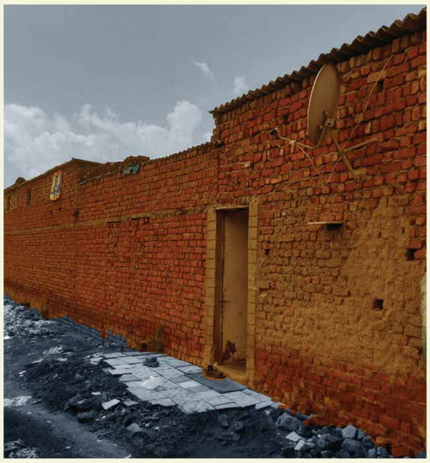
બાંધકામ સામગ્રી

ટીન જેવી હલકી સામગ્રી ગરમી અને પવનની ગતિ વધારે છે, જ્યારે કોંક્રિટ જેવી ગાઢ સામગ્રી હવાના પ્રવાહને અવરોધે છે, જે વેન્ટિલેશન અને આરામને અસર કરે છે.

BUILDING MATERIAL

Lightweight materials like tin increase heat and wind turbulence, while dense materials like concrete block airflow, affecting ventilation and comfort.

7



सतह खुरदरापन

असमतल भूभाग और इमारतें हवा को धीमा कर देती हैं, जिससे ठहराव पैदा होता है, गर्मी और आर्द्रता बाधित होती है, तथा उबड़-खाबड़ सतहों में गर्मी फंस जाती है।

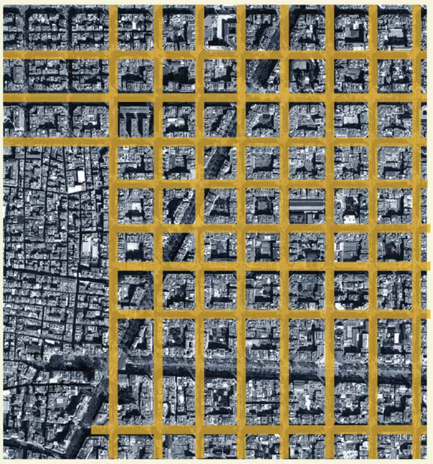
સપાટીની ખરબચડીતા

અસમાન ભૂપ્રદેશ અને ઇમારતો પવનને ધીમો પાડે છે, જેના કારણે સ્થિરતા આવે છે, ગરમી અને ભેજમાં ખલેલ પહોંચે છે અને ખરબચડી સપાટીઓમાં ગરમી

SURFACE ROUGHNESS

Uneven terrain and buildings slow wind, causing stagnation, disrupting heat and humidity, and trapping heat in rough surfaces.

8



आयताकार ब्लॉक

ग्रिड लेआउट वायु सुरंगों और ताप निर्माण का निर्माण करते हैं, जिससे नेविगेशन में सहायता मिलती है, लेकिन इसमें जैविक डिजाइनों के सूक्ष्म-जलवायु संबंधी लाभों का अभाव होता है।

લંબચોરસ બ્લોક

ગ્રીડ લેઆઉટ પવન ટનલ અને ગરમીનું નિર્માણ બનાવે છે, જે નેવિગેશનમાં મદદ કરે છે પરંતુ કાર્બનિક ડિઝાઇનના સૂક્ષ્મ-આબોહવા લાભોનો અભાવ ધરાવે છે.

RECTANGULAR BLOCK

Grid layouts create wind tunnels and heat build-up, helping in navigation but lacking the micro-climatic benefits of organic designs.

9

पागल पैटर्न

जैविक डिजाइन, तेज हवाओं और विभिन्न वायु पैटर्न और छाया के साथ गर्मी के निर्माण को कम करके वायु प्रवाह और आराम में सुधार करते हैं।

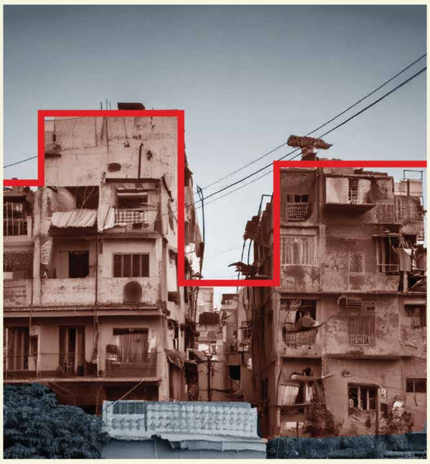
ક્રેઝી પેટર્ન

ઓર્ગેનિક લેઆઉટ વિવિધ પવન પેટર્ન અને છાંયો સાથે તીવ્ર પવન અને ગરમીના સંચયને ઘટાડીને હવાના પ્રવાહ અને આરામમાં સુધારો કરે છે.

CRAZY PATTERN

Organic layouts improve airflow and comfort by reducing strong winds and heat buildup with diverse wind patterns and shade.

10



इमारत की ऊंचाई

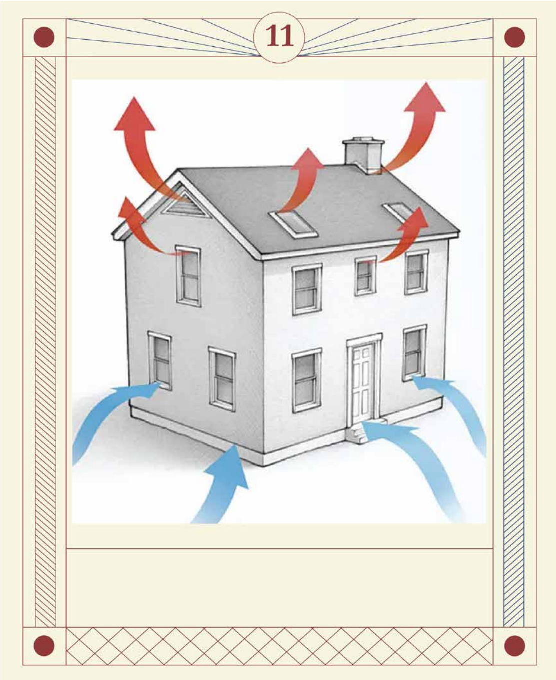
भवन की ऊंचाई, सड़क की चौड़ाई और लंबाई का अनुपात हवा के प्रवाह को प्रभावित करता है, जिसे सड़कों में वायु प्रवाह को अनुकूलित करने के लिए समायोजित किया जा सकता है।

મકાનની ઊંચાઈ

ઇમારતની ઊંચાઈ, શેરીની પહોળાઈ અને લંબાઈનો ગુણોત્તર પવનના પ્રવાહને અસર કરે છે, જેને શેરીઓમાં હવાના પ્રવાહને શ્રેષ્ઠ બનાવવા માટે ગોઠવી શકાય છે.

BUILDING HEIGHT

The ratio of building height, street width, and length affects wind flow, which can be adjusted to optimize airflow in streets.



तापमान अंतराल

तापमान में अंतर के कारण हवा का पैटर्न प्रभावित होता है, गर्म क्षेत्र ठंडी हवा को खींचते हैं और ठंडे क्षेत्र हवा को नीचे की ओर धकेलते हैं, जिससे वायु प्रवाह और आराम प्रभावित होता है।

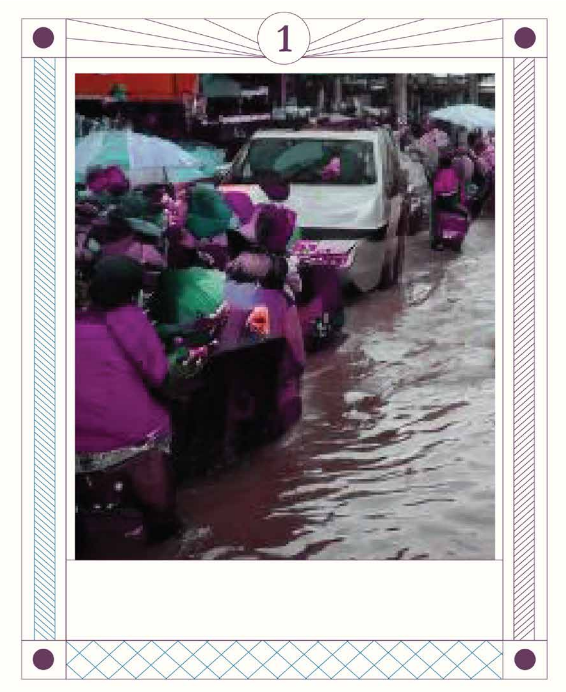
તાપમાન તફાવત

તાપમાનના તફાવત પવનની પેટર્નને ચલાવે છે, ગરમ વિસ્તારો ઠંડી હવા ખેંચે છે અને ઠંડા વિસ્તારો હવાને નીચે ધકેલે છે, જે હવાના પ્રવાહ અને આરામને અસર કરે છે.

TEMPERATURE DIFFERENCE

Temperature differences drive wind patterns, with warm areas pulling in cooler air and cool areas pushing air down, affecting airflow and comfort.

Impact



परिवहन समस्याएँ

जलभराव के कारण सार्वजनिक परिवहन बाधित हो जाता है, जिससे कामगार काम पर नहीं पहुंच पाते और बच्चे स्कूल नहीं जा पाते, जिससे वेतन का नुकसान होता है और शिक्षा बाधित होती है

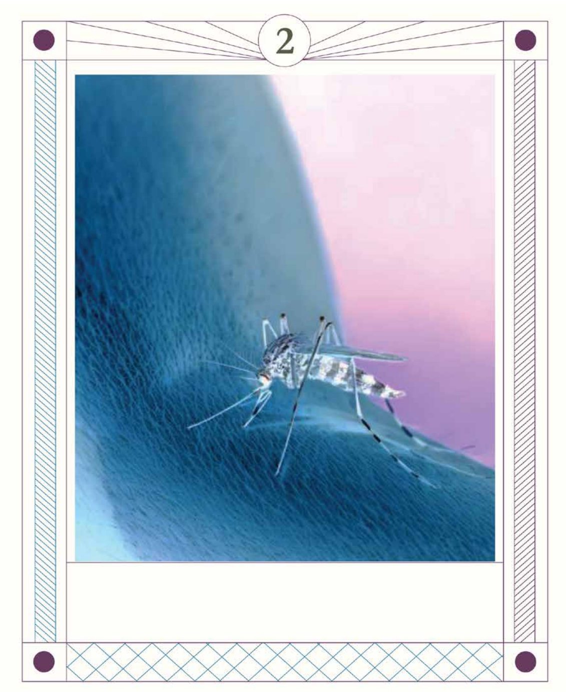
પરિવહન સમસ્યાઓ

પાણી ભરાવાથી જાહેર પરિવહન ઠપ્પ, કામદારો નોકરી પર પહોંચી શકતા નથી અને બાળકો શાળાએ જઈ શકતા નથી, જેના કારણે વેતન ગુમાવવું પડે છે અને શિક્ષણ ખોરવાઈ જાય છે.

TRANSPORT PROBLEMS

Vulnerable users: Manual labourers, daily wage earners

Waterlogging halts public transport, preventing workers from reaching jobs and children from attending school, causing lost wages and disrupted education



मलेरिया और डेंगू

दगी भरी सड़कों और खुले बर्तनों में जमा पानी मच्छरों को जन्म देता है, जिससे डेंगू बुखार का खतरा बढ़ जाता है, जो एक गंभीर बीमारी है और मां से बच्चे में फैल सकती है।

મેલેરિયા અને ડેન્ગ્યુ

ધૂળિયા રસ્તાઓ અને ખુલ્લા કન્ટેનરમાં ભરાયેલા પાણીથી મચ્છરો ઉત્પન્ન થાય છે, જેના કારણે ડેન્ગ્યુ તાવનું જોખમ વધે છે, જે એક ગંભીર રોગ છે જે માતાથી બાળકમાં ફેલાઈ શકે છે.

MALARIA & DENGUE

Vulnerable users: Children, pregnant women, old people

Stagnant water on dirt roads and in open containers breeds mosquitoes, raising the risk of dengue fever, a serious disease that can spread from mother to baby.

3

बंद नालियाँ

अपशिष्ट निपटान की खराब व्यवस्था के कारण नालियां जाम हो जाती हैं, जिससे पानी ओवरफ्लो हो जाता है और जल संदूषित हो जाता है, जिससे हैजा जैसी बीमारियां फैलती हैं।

ભરાયેલા ગટર

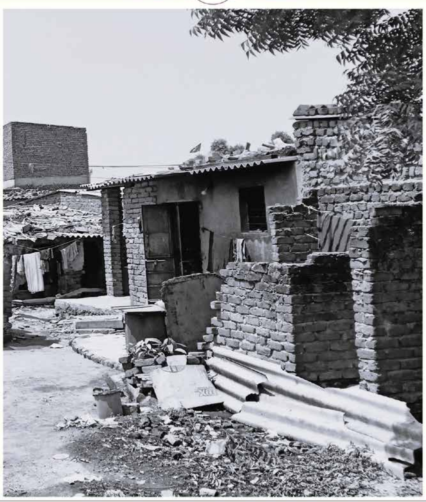
કચરાનો યોગ્ય નિકાલ ન થવાથી ગટરો ભરાઈ જાય છે, જેના કારણે પાણી ઓવરફ્લો થાય છે અને પાણી દૂષિત થાય છે, જેના કારણે કોલેરા જેવા રોગો થાય છે.

CLOGGED DRAINS

Vulnerable users: Children, pregnant women, old people

Poor waste disposal clogs drains, causing overflows and water contamination, leading to diseases like cholera.

4



इमारत को नुकसान

खराब तरीके से बनी सड़कों पर गड्ढे हो जाते हैं और कमज़ोर विद्युत व्यवस्था के कारण बिजली गुल हो जाती है। टिन शीट जैसी सामग्री से बने घर असुरक्षित हैं

મકાનને નુકસાન

ખરાબ રીતે બનેલા રસ્તાઓ ખાડાઓ બનાવે છે, અને નબળી વિદ્યુત પ્રણાલીઓને કારણે વીજળી ગુલ થાય છે. ટીન શીટ જેવી સામગ્રીથી બનેલા ઘરો સંવેદનશીલ હોય છે.

BUILDING DAMAGE

Vulnerable users: Manual workers, daily wage earners

Poorly built roads develop potholes, and weak electrical systems cause power outages. Houses made of materials like tin sheets are vulnerable

5

ज़हरीली गैसें

कचरे को जलाने से कार्बन मोनोऑक्साइड, सल्फर डाइऑक्साइड और नाइट्रोजन ऑक्साइड जैसी हानिकारक गैसें निकलती हैं, जिससे श्वसन और हृदय संबंधी बीमारियाँ होती हैं

ઝેરી વાયુઓ

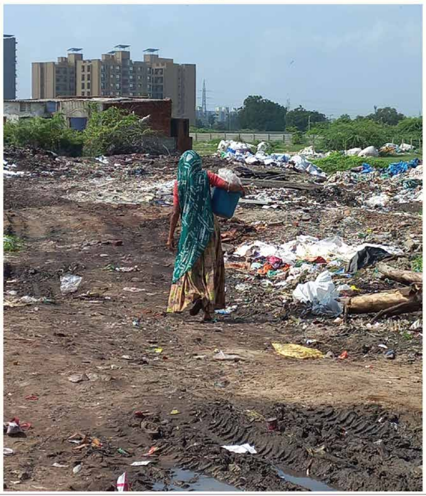
કચરો બાળવાથી કાર્બન મોનોક્સાઇડ, સલ્ફર ડાયોક્સાઇડ અને નાઇટ્રોજન ઓક્સાઇડ જેવા

TOXIC GASES

Vulnerable users: Children, pregnant women, old people, stray animals and birds

Burning waste releases harmful gases like carbon monoxide, sulfur dioxide, and nitrogen oxides, causing respiratory and heart diseases

7



मृदा संदूषण

अनुपचारित अपशिष्ट से विषाक्त रसायन मिट्टी में रिस जाते हैं, जिससे गुणवत्ता को नुकसान पहुंचता है और जलभराव होता है।

માટીનું દૂષણ

પ્રક્રિયા ન કરાયેલ કચરામાંથી ઝેરી રસાયણો માટીમાં ભળી જાય છે, જેનાથી ગુણવત્તાને નુકસાન થાય છે અને

SOIL CONTAMINATION

Vulnerable users: Everyone

Toxic chemicals from untreated waste seep into soil, harming quality and causing waterlogging.

6

कवक वृद्धि

मोल्ड एक ऐसा फंगस है जो नमी वाले इलाकों में पनपता है और स्वास्थ्य को नुकसान पहुंचाता है। यह प्रतिरक्षा प्रणाली को कमजोर करता है और लंबे समय तक संपर्क में रहने से फेफड़ों में बढ़ सकता है।

ફૂગનો વિકાસ

ફૂગ એ એક ફૂગ છે જે ભીના વિસ્તારોમાં ખીલે છે અને સ્વાસ્થ્યને નુકસાન પહોંચાડે છે. તે રોગપ્રતિકારક

FUNGAL GROWTH

Vulnerable users: Children, pregnant women, old people,

Mold is a fungus that thrives in damp areas and harms health. It weakens the immune system and can grow in the lungs with long exposure.

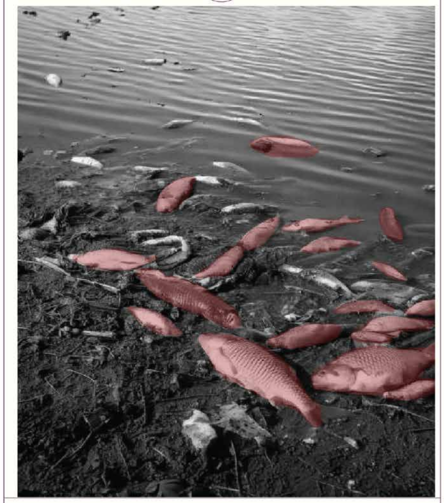
8

WATER CONTAMINATION

Vulnerable users : Everyone, aquatic life

Toxic leachate from poorly managed landfills harms fish.

9



मछलियों के लिए विषैला

खराब तरीके से प्रबंधित लैंडफिल से निकलने वाला जहरीला पदार्थ जलीय पारिस्थितिकी तंत्र को नुकसान पहुंचाता है।

માછલી માટે ઝેરી

ખરાબ રીતે સંચાલિત લેન્ડફિલ્સમાંથી નીકળતા ઝેરી લીચેટ પાણીની ઇકોસિસ્ટમને નુકસાન પહોંચાડે છે.

TOXIC TO FISH

Vulnerable users: everyone, aquatic life

Toxic leachate from poorly managed landfills harms fish.

11

सतह विक्षेपण

कोणीय या धंसे हुए अग्रभाग हवा को विक्षेपित करते हैं, अशांति को कम करते हैं और बेहतर शीतलन और आराम के लिए वायु प्रवाह में सुधार करते हैं।

સપાટીનું વિચલન

ખૂણાવાળા અથવા રિસેસ્ડ રવેશ પવનને વિચલિત કરે છે, તોફાન ઘટાડે છે અને સારી ઠંડક અને આરામ માટે હવાના પ્રવાહમાં સુધારો કરે છે.

SURFACE DEFLECTION

Angled or recessed facades deflect wind, reducing turbulence and improving airflow for better cooling and comfort.

10

आजीविका

भारत के जल निकाय मछुआरों और किसानों के लिए महत्वपूर्ण हैं। एक अध्ययन में पाया गया कि प्रदूषित गंगा जल के उपयोग से निमोनिया, डायरिया जैसी बीमारियाँ होती हैं।

આજીવિકા

ભારતના જળસ્ત્રોત માછીમારો અને ખેડૂતો માટે મહત્વપૂર્ણ છે. એક અભ્યાસમાં જાણવા મળ્યું છે કે પ્રદૂષિત ગંગા પાણીનો ઉપયોગ કરવાથી ન્યુમોનિયા, ઝાડા જેવા રોગો થાય છે.

LIVELIHOOD LOSS

Vulnerable users: Everyone

Earning an income becomes difficult with all of these problems.

12

अशांति

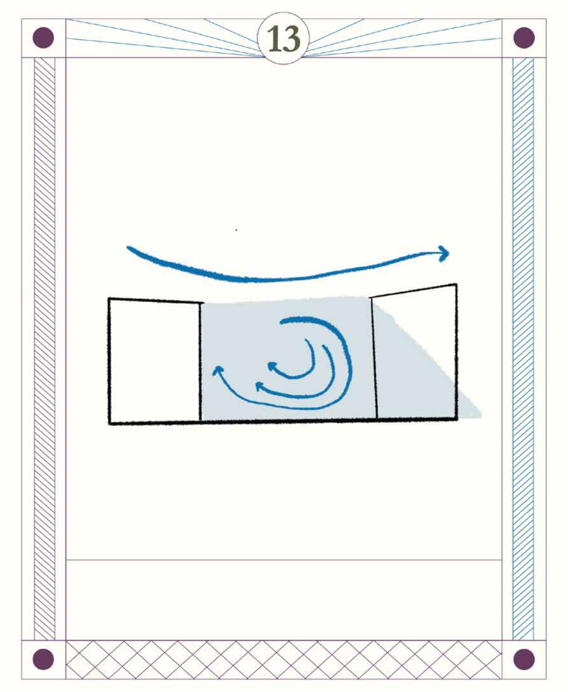
संकरी, घुमावदार सड़कें हवा को धीमा कर देती हैं, जिससे वेंटिलेशन खराब हो जाता है और हवा फंस जाती है, अशांत हो जाती है।

તોફાન

સાંકડી, વળાંકવાળી શેરીઓ ધીમી પવનને કારણે ખરાબ વેન્ટિલેશન અને ફસાયેલી, તોફાની હવાનું કારણ બને છે.

TURBULENCE

Narrow, winding streets slow wind, causing poor ventilation and trapped, turbulent air.



स्कीमिंग प्रवाह

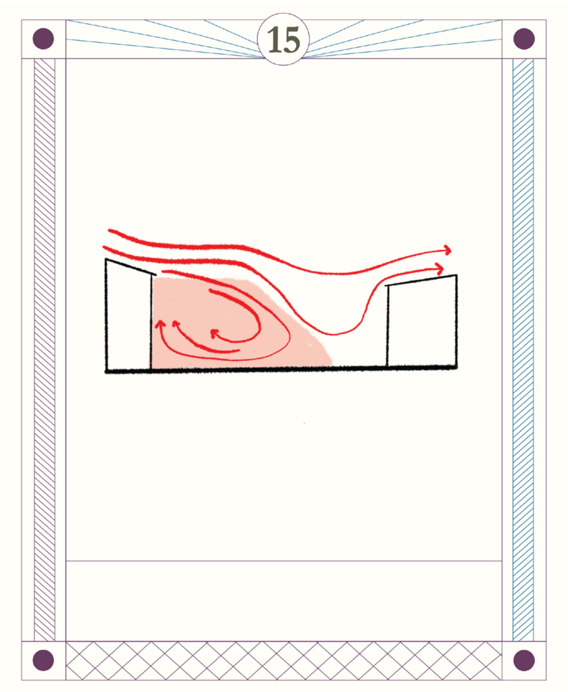
कुछ निश्चित ऊंचाई पर स्थित इमारतों में हवा छतों के ऊपर से बहती है, जिससे सड़कें स्थिर रहती हैं, लेकिन कुछ क्षेत्रों में आरामदायक वायु प्रवाह में सुधार होता है।

સ્કિમિંગ ફ્લો

ચોક્કસ ઇમારતોની ઊંચાઈએ, છત ઉપર પવન વહે છે, જેના કારણે શેરીઓ સ્થિર રહે છે પરંતુ કેટલાક વિસ્તારોમાં આરામ માટે હવાના પ્રવાહમાં સુધારો થાય

SKIMMING FLOW

At certain building heights, wind flows above roofs, leaving streets still but improving airflow for comfort in some areas.



पृथक खुरदरापन प्रवाह

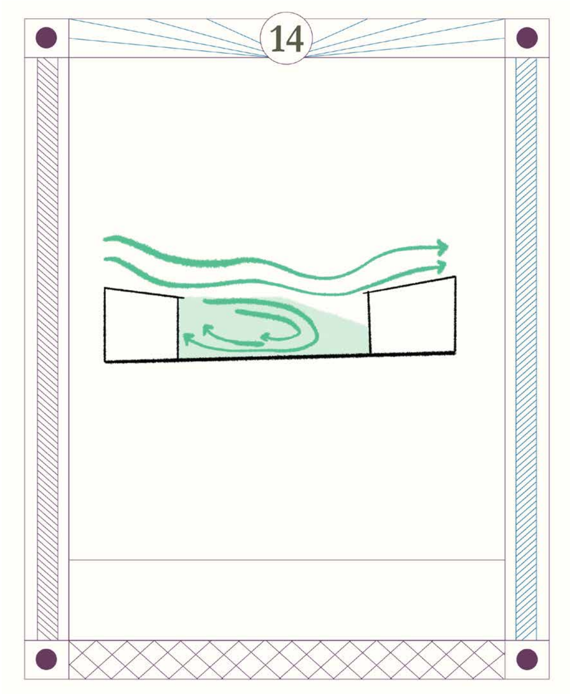
जब इमारतें एक दूसरे से दूर होती हैं तो हवा स्वतंत्र रूप से बहती है, जिससे वेंटिलेशन बेहतर होता है, लेकिन हवा की गति, धूल और प्रदूषक फैलते हैं।

અલગ રફનેસ પ્રવાહ

જ્યારે ઇમારતો એકબીજાથી દૂર હોય છે ત્યારે પવન મુક્તપણે વહે છે, જેનાથી વેન્ટિલેશનમાં સુધારો થાય છે પરંતુ પવનની ગતિ, ધૂળ અને પ્રદૂષકોનો ફેલાવો વધે

ISOLATED ROUGHNESS FLOW

When buildings are far apart wind flows freely, improving ventilation but increasing wind speed, dust, and pollutant spread.



वेक इंटरफ़ेस प्रवाह

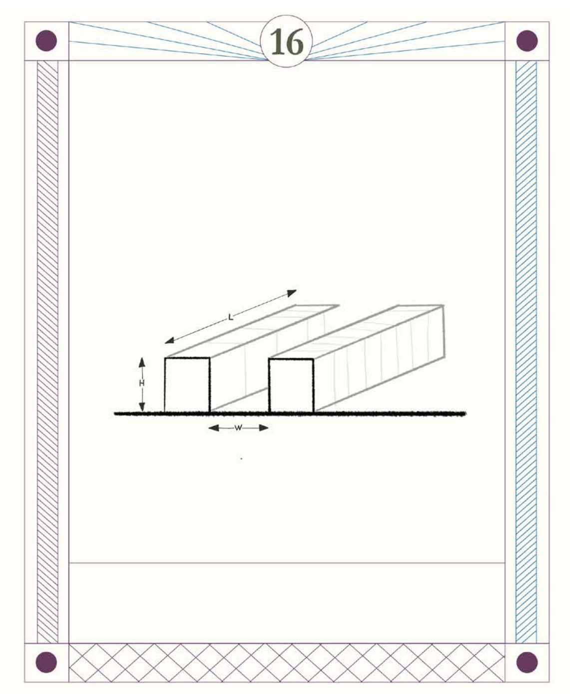
मध्यम भवन ऊंचाई-सड़क चौड़ाई अनुपात के कारण हवा अशांति पैदा करती है, जिससे वायु-संचार बेहतर होता है, लेकिन झोंके और तापमान में परिवर्तन होता है।

વેક ઇન્ટરફેસ ફ્લો

મધ્યમ ઇમારતની ઊંચાઈ અને શેરીની પહોળાઈના ગુણોત્તરમાં પવન તોફાની વાતાવરણ બનાવે છે, વેન્ટિલેશનમાં સુધારો કરે છે પરંતુ પવનના તોફાન

WAKE INTERFACE FLOW

With a moderate building height-to-street width ratio wind creates turbulence, improving ventilation but causing gusts and temperature changes.



स्ट्रीट घाटी

ऊंची इमारतें हवा को नियंत्रित करती हैं, जिससे गति, अशांति और गर्मी बढ़ती है। छोटी इमारतें हवा के प्रवाह और आराम को बेहतर बनाती हैं।

સ્ટ્રીટ કેન્યન

ઊંચી ઇમારતો પવન, વધતી ગતિ, તોફાન અને ગરમીને પ્રોત્સાહન આપે છે. નાની ઇમારતો હવાના પ્રવાહ અને આરામમાં સુધારો કરે છે.

STREET CANYON

Tall buildings channel wind, increasing speed, turbulence, and heat. Shorter ones improve airflow and comfort.

Strategies

जल निकासी व्यवस्था

सड़कों और घरों में बाढ़ और पानी के जमाव को रोकने के लिए पाइप, खाई या नालियों के माध्यम से वर्षा जल या अपशिष्ट जल को सुरक्षित रूप से ले जाने का एक तरीका ।

ડ્રેનેજ સિસ્ટમ્સ

શેરીઓ અને ઘરોમાં પૂર અને પાણી જમા થતા અટકાવવા માટે પાઈપો, ખાડાઓ અથવા ગટર દ્વારા વરસાદી પાણી અથવા ગંદુ પાણીને સુરક્ષિત રીતે વહન કરવાનો માર્ગ.

DRAINAGE SYSTEM

a way to safely carry away rainwater or wastewater through pipes, ditches, or drains to prevent flooding and water buildup in streets and homes.

मिट्टी में सुधार

पोषक तत्व, कार्बनिक पदार्थ, या उचित जल निकासी जोड़ने से पौधों के बेहतर विकास और कटाव को रोकने के लिए यह स्वस्थ हो जाएगा।

માટી સુધારવી

પોષક તત્ત્વો, કાર્બનિક પદાર્થો અથવા યોગ્ય ડ્રેનેજ ઉમેરવાથી છોડ વધુ સારી રીતે વૃદ્ધિ પામશે અને ધોવાણ અટકાવશે.

IMPROVING SOIL

Adding nutrients, organic matter, or proper drainage to make it healthier for plants to grow better and prevent erosion.

समतल भूमि

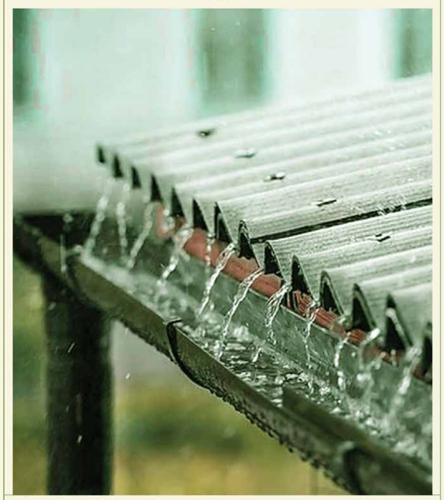
उचित जल प्रवाह सुनिश्चित करने और निचले इलाकों में पानी जमा होने से रोकने के लिए भूमि को समतल या समोच्च बनाना।

સપાટ જમીન

પાણીના યોગ્ય પ્રવાહને સુનિશ્ચિત કરવા અને નીચાણવાળા વિસ્તારોમાં પાણીને એકઠું થતું અટકાવવા માટે જમીનનું સ્તરીકરણ અથવા સમોચ્ચ કરવું.

FLAT LAND

Leveling or contouring the land to ensure proper water flow and prevent water from pooling in low-lying areas.



जल छाजन

छतों या सतहों से वर्षा जल को इकट्ठा करने और संग्रहीत करने की प्रक्रिया, ताकि बाद में इसे बर्बाद करने के बजाय पीने, खेती या अन्य जरूरतों के लिए उपयोग किया जा सके।

રેઇન વૉટર હાર્વેસ્ટિંગ

વરસાદી પાણીને કચરો જવા દેવાને બદલે પછીથી પીવા, ખેતી અથવા અન્ય જરૂરિયાતો માટે વાપરવા માટે છત અથવા સપાટી પરથી વરસાદી પાણી એકત્ર કરવાની અને સંગ્રહિત કરવાની પ્રક્રિયા.

RAINWATER HARVESTING

Process of collecting and storing rainwater from rooftops or surfaces to use later for drinking, farming, or other needs, instead of letting it go to waste.

अंतःस्राव गड्ढा

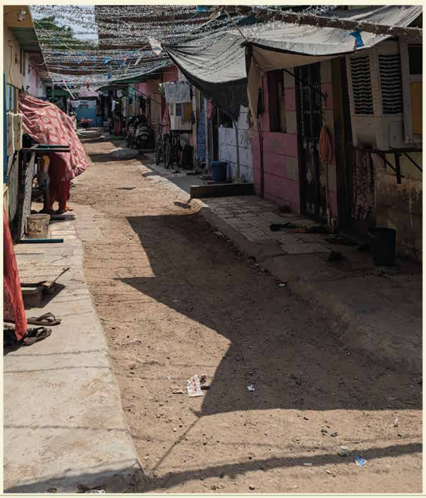
बजरी या मोटे रेत से भरी उथली, बिना लाइन वाली खुदाई इस तरह से की जाती है कि बारिश का पानी जमीन में रिस सके, जिससे भूजल पुनर्भरण में मदद मिलेगी।

પરકોલેશન પિટ

કાંકરી અથવા બરછટ રેતીથી ભરેલા છીછરા, અનલાઇન કરેલા ખોદકામને વરસાદી પાણીને જમીનમાં પ્રવેશવાની મંજૂરી આપવા માટે ડિઝાઇન કરવામાં આવે છે, જે ભૂગર્ભજળના રિચાર્જમાં મદદ કરે છે.

PERCOLATION PIT

Shallow, unlined excavations filled with gravel or coarse sand designed to allow rainwater to seep into the ground, aiding groundwater recharge.



PLINTH HEIGHT

The height of the base of a building (plinth) above the surrounding ground level, ensuring protection from flooding, water-logging, and dampness.

जैव उपचार

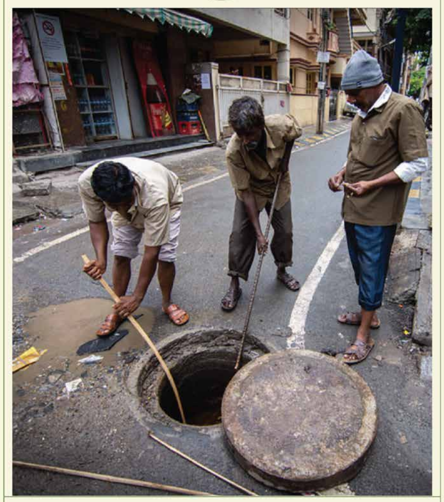
एक प्रक्रिया जो मिट्टी, पानी और अन्य वातावरण से दूषित पदार्थों, प्रदूषकों या विषाक्त पदार्थों को साफ करने और हटाने के लिए सूक्ष्म जीवों, पौधों या एंजाइमों का उपयोग करती है।

બાયોરિમેડિયેશન

એક પ્રક્રિયા જે માટી, પાણી અને અન્ય વાતાવરણમાંથી દૂષકો, પ્રદૂષકો અથવા ઝેરને સાફ કરવા અને દૂર કરવા માટે સૂક્ષ્મ જીવો, છોડ અથવા ઉત્સેચકોનો ઉપયોગ કરે છે.

BIO RE-MEDIATION

A process that uses micro-organisms, plants, or enzymes to clean up and remove contaminants, pollutants, or toxins from soil, water, and other environments.



सीवेज रखरखाव

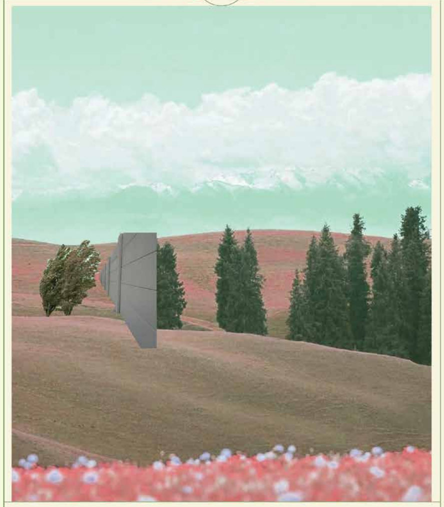
रुकावटों और रिसाव को रोकने और अपशिष्ट जल के सुचारू प्रवाह को सुनिश्चित करने के लिए सीवर सिस्टम का नियमित रूप से निरीक्षण, सफाई, मरम्मत और प्रबंधन करें।

ગટરની જાળવણી

અવરોધો અને લિકેજને રોકવા અને ગંદા પાણીના સરળ પ્રવાહને સુનિશ્ચિત કરવા માટે ગટર વ્યવસ્થાનું નિયમિત નિરીક્ષણ, સફાઈ, સમારકામ અને સંચાલન જરૂરી છે.

SEWERAGE MAINTENANCE

The regular inspection, cleaning, repair, and management of sewer systems to prevent blockages and leaks and ensure the smooth flow of wastewater.



पवन अवरोध

दीवारों, बाड़ों या पेड़ों जैसी संरचनाओं को इस तरह से रखा जाता है कि इमारतों, फसलों या बाहरी स्थानों को क्षति और असुविधा से बचाने के लिए तेज़ हवाओं को धीमा या पुनर्निर्देशित किया जा सके।

પવન અવરોધો

દિવાલો, વાડ અથવા વૃક્ષો જેવી રચનાઓ એવી રીતે મૂકવામાં આવે છે જે ઇમારતો, પાકો અથવા બહારની જગ્યાઓને નુકસાન અને અગવડતાથી બચાવવા માટે તેજ પવનને ધીમો પાડે છે અથવા રીડાયરેક્ટ કરે છે.

WIND BARRIERS

Structures like walls, fences, or trees placed in a way that slows down or redirects strong winds to protect buildings, crops, or outdoor spaces from damage and discomfort.

सड़क अवसंरचना

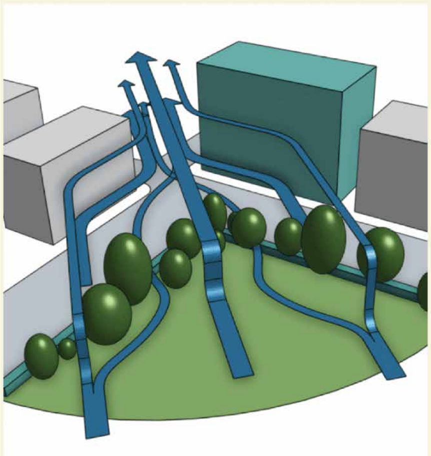
सड़कों को कार्यात्मक और सुरक्षित बनाने वाले आवश्यक तत्वों में सड़कें, फुटपाथ, जल निकासी, स्ट्रीटलाइट्स, यातायात सिग्नल और सार्वजनिक बैठने की व्यवस्था शामिल हैं।

સ્ટ્રીટ ઈન્ફ્રાસ્ટ્રક્ચર

આવશ્યક તત્વો જે શેરીઓને કાર્યાત્મક અને સલામત બનાવે છે, જેમ કે રસ્તાઓ, ફૂટપાથ, ડ્રેનેજ, સ્ટ્રીટલાઇટ, ટ્રાફિક સિગ્નલ અને જાહેર બેઠક.

STREET INFRASTRUCTURE

Essential elements that make streets functional and safe, such as roads, sidewalks, drainage, streetlights, traffic signals, and public seating.



पवन विक्षेपक

संरचनाओं या सतहों को हवा के प्रवाह की दिशा बदलने, इमारतों, वाहनों या खुले स्थानों पर इसके प्रभाव को कम करने और आराम और स्थिरता में सुधार करने के लिए डिज़ाइन किया गया है।

વિન્ડ ડિફ્લેક્ટર

માળખું અથવા સપાટીઓ પવનના પ્રવાહની દિશા બદલવા, આરામ અને સ્થિરતા સુધારવા માટે ઇમારતો, વાહનો અથવા ખુલ્લી જગ્યાઓ પર તેની અસર ઘટાડવા માટે ડિઝાઇન કરવામાં આવી છે.

WIND DEFLECTORS

Structures or surfaces designed to change the direction of wind flow, reducing its impact on buildings, vehicles, or open spaces to improve comfort and stability.

नीति एवं विनियमन

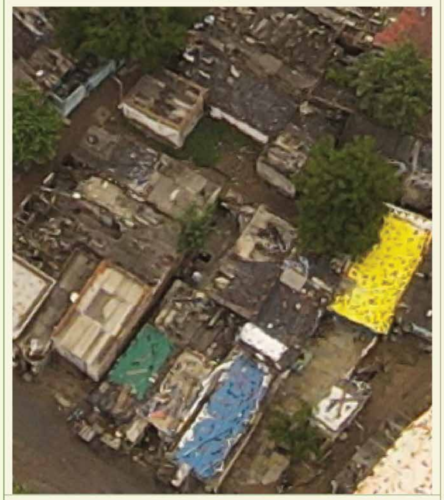
शहरों और समुदायों के सुरक्षित, टिकाऊ और संगठित विकास को सुनिश्चित करने के लिए भूमि का उपयोग, विकास और रखरखाव कैसे किया जाए, इसे नियंत्रित करने के लिए नियम और दिशानिर्देश।

નીતિ અને નિયમન

શહેરો અને સમુદાયોના સુરક્ષિત, ટકાઉ અને સંગઠિત વિકાસને સુનિશ્ચિત કરવા માટે જમીનનો ઉપયોગ, વિકાસ અને જાળવણી કેવી રીતે કરવામાં આવે છે તેના નિયંત્રણ માટે નિયમો અને માર્ગદર્શિકા.

POLICY & REGULATION

rules and guidelines to control how land is used, developed, and maintained to ensure safe, sustainable, and organized growth of cities and communities.



छत का कोण

छत कोणछत का कोण हवा के प्रवाह को प्रबंधित करने, वेंटिलेशन में सुधार करने और गर्मी के संचय को कम करने में मदद करता है, जिससे इमारतें अधिक स्थिर, आरामदायक और ऊर्जा कुशल बनती हैं।

છત કોણ

છતનો કોણ પવનના પ્રવાહને સંચાલિત કરવામાં, વેન્ટિલેશનને સુધારવામાં અને ગરમીનું નિર્માણ ઘટાડવામાં મદદ કરે છે, જે ઇમારતોને વધુ સ્થિર, આરામદાયક અને ઊર્જા-કાર્યક્ષમ બનાવે છે.

ROOF ANGLES

The angle of a roof helps manage wind flow, improve ventilation, and reduce heat buildup, making buildings more stable, comfortable, and energy-efficient.

सिस्टम को औपचारिक बनाना

अपशिष्ट प्रबंधन या बुनियादी ढांचे की योजना जैसी प्रक्रियाओं को व्यवस्थित और मानकीकृत करना, ताकि उन्हें सभी के लिए अधिक कुशल, विश्वसनीय और सुलभ बनाया जा सके।

સિસ્ટમોનું ઔપચારિકકરણ

વેસ્ટ મેનેજમેન્ટ અથવા ઇન્ફ્રાસ્ટ્રક્ચર પ્લાનિંગ જેવી પ્રક્રિયાઓને વધુ કાર્યક્ષમ, ભરોસાપાત્ર અને દરેક માટે સુલભ બનાવવાનું આયોજન અને માનકીકરણ.

FORMALIZING THE SYSTEM

Organizing and standardizing processes, like waste management or infrastructure planning, to make them more efficient, reliable, and accessible for everyone.

मुखौटा

मुखौटे में तत्वों को जोड़ने या हटाने से हवा को मोड़ने और पुनर्निर्देशित करने, गर्मी के प्रवेश को नियंत्रित करने, वेंटिलेशन बढ़ाने और इनडोर आराम और ऊर्जा दक्षता में सुधार करने में मदद मिलती है।

રવેશ

રવેશમાં તત્વો ઉમેરવા અથવા દૂર કરવાથી પવનને વિચલિત કરવામાં અને રીડાયરેક્ટ કરવામાં, ગરમીના પ્રવેશને નિયંત્રિત કરવામાં, વેન્ટિલેશન વધારવામાં અને ઘરની અંદર આરામ અને ઊર્જા

THE FACADE

Adding or removing elements in the facade, helps deflect and redirect wind, controlling heat entry, enhancing ventilation, and improving indoor comfort and energy efficiency.

अपशिष्ट पृथक्करण

पुनर्चक्रण योग्य सामग्रियों को गैर-पुनर्चक्रण योग्य कचरे से अलग करने के लिए घरों, दुकानों और स्कूलों में जागरूकता बढ़ाना। कचरे के मिश्रण को रोकने के लिए कचरे को उसके स्रोत पर ही अलग करना।

કચરાનું વિભાજન

રિસાયકલ ન કરી શકાય તેવા કચરામાંથી રિસાયકલ કરી શકાય તેવી સામગ્રીને અલગ કરવા માટે ઘરો, દુકાનો અને શાળાઓમાં જાગૃતિ કેળવવી. કચરાના મિશ્રણને રોકવા માટે કચરાને તેના સ્ત્રોત પર અલગ

WASTE SEGREGATION

Raising awareness in households, shops and schools to separate recyclable materials from non-recyclable waste. Segregating the waste at its source to prevent mixing of garbage.

पुनर्चक्रण

अपशिष्ट जलने को कम करने के लिए पुनर्चक्रण योग्य सामग्रियों को लैंडफिल से और खुले मैदानों में जमा होने से हटाने के लिए पुनर्चक्रण प्रणालियाँ।

રિસાયકલ કરો

રિસાયક્લિંગ સિસ્ટમ્સ લેન્ડફિલ્સમાંથી રિસાયકલ કરી શકાય તેવી સામગ્રીને અને ખુલ્લા મેદાનમાં એકઠા થવાથી કચરાને બાળી નાખવામાં ઘટાડો કરે છે.

RECYCLING

Recycling systems to divert recyclable materials from landfills and from accumulating in open grounds to minimize waste burning.

Sitting/ Relaxing Outside

After the days work and when the heat has passed people gather to sit near their doors and otlas to catch-up and share stories.

जागरूकता

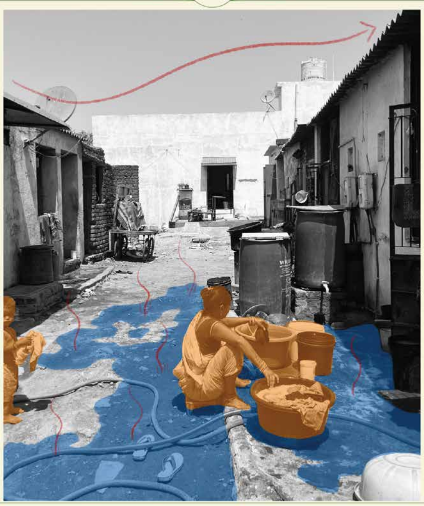
सुरक्षित, वैकल्पिक अपशिष्ट निपटान विधियों को बढ़ावा देते हुए समुदायों को रुके हुए पानी और अपशिष्ट जलाने से होने वाले स्वास्थ्य जोखिमों जैसे मलेरिया, डेंगू और श्वसन संबंधी समस्याओं के बारे में शिक्षित करना।

જાગૃતિ

સલામત, વૈકલ્પિક કચરાના નિકાલની પદ્ધતિઓનો પ્રચાર કરતી વખતે સ્થિર પાણી અને કચરાને બાળવાથી થતા મેલેરિયા, ડેન્ગ્યુ અને શ્વસન સંબંધી સમસ્યાઓ જેવા આરોગ્યના જોખમો વિશે સમુદાયોને શિક્ષિત કરવું.

AWARENESS

Educating communities about health risks like malaria, dengue, and respiratory issues caused by stagnant water and burning waste, while promoting safer, alternative waste disposal methods.

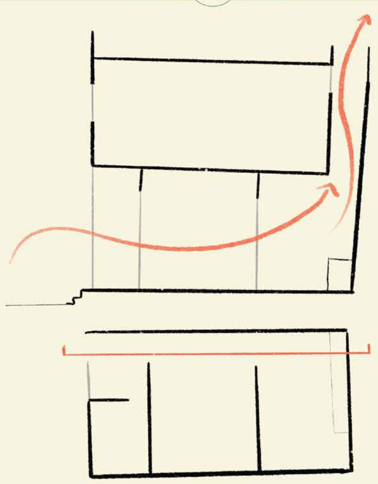


Sprinkling Water Near Door

Sprinkling water near the door to reduce the dust from entering the house and to increse comfort when the wind enters passing through it.

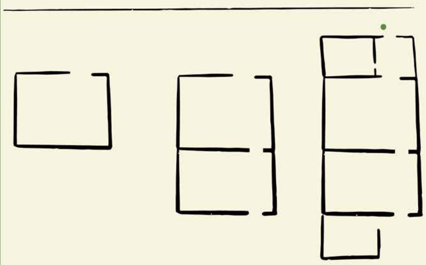
Traping Cold

Opening and closing doors and windows in a paticular time to trap the cold inside the house to increase comfort in the house.



Vent

In G+1 houses that do not have the provision to keep windows for ventilation can have aopen double height space to ensure ventilation.



Horizontal Expantion

Expanding the houses horizontaly reducing the width of the street. When the building is vertically increased it becomes prone to upwinds and does not last long.

Food Habits

Eating solid foods less during summer and increasing the intake of liquid and watery fruits and vegetables.

Data Collected From Site

Vatva										
Location	Air Temperature			Wind Speed m/s			Humidity	Humidity	NAQI	Temperature
	Min	Max	Average	Min	Max	Average		(from weather station)		
Day 1									19/03/2025	
A	38.5	38.9	38.7	0	0.5	0.25	13.4	19	150	36
B	37.8	39.5	38.65	0.2	0.4	0.3	18.3	19	150	36
C	39.5	40.3	39.9	0	0.5	0.25	20.4	19	150	36
D	37.9	38.5	38.2	0.3	1.2	0.75	14.6	19	150	36
Day 2									21/03/2025	
A	36.5	37.8	37.15	0	0.2	0.1	18.3	35	160	35
B	38.3	39.2	38.75	0	0	0	20.8	35	160	35
C	38.5	39	38.75	0.5	0.9	0.7	22.5	35	160	35
D	37.6	38.7	38.15	0.8	1.4	1.1	18.2	35	160	35
Day 3									22/03/2025	
A	36.8	38	37.4	0	0.3	0.15	17.5	25	138	36
B	37.3	37.9	37.6	0	0.5	0.25	22.5	25	138	36
C	40.2	40.9	40.55	0.2	1.3	0.75	25.3	25	138	36
D	36.5	38.3	37.4	0.4	1.2	0.8	16.9	25	138	36
Day 4									23/03/2025	
A	38	41	39.5	0	0	0	18.7	22	154	37
B	39.4	40	39.7	0	0.7	0.35	23	22	154	37
C	40	42	41	0.5	1.8	1.15	27.4	22	154	37
D	38.2	38.6	38.4	0.7	1	0.85	16.4	22	154	37
Day 5									12/03/2025	
A	39	42	40.5	0	0.4	0.2	21	29%	164	35
B	40	41	40.5	0.2	0.5	0.35	24.4	29%	164	35
C	39.2	40	39.6	0.2	0.7	0.45	28	29%	164	35
D	38.9	39.5	39.2	0.3	1	0.65	20.7	29%	164	35

Berampura

Location	Air Temperature			Wind Speed m/s			Humidity	Humidity	NAQI	Temperature
	Min	Max	Average	Min	Max	Average		(from weather station)		
Day 1										**06/03/2025**
A	32.7	33.8	33.25	0	0.2	0.1	20	21%	70	35
B	34	34.2	34.1	0.4	1.2	0.8	19	21%	70	35
C	33.6	33.6	33.6	0	0	0	22	21%	70	35
D	34.5	35	34.75	0	0.2	0.1	18	21%	70	35
Day 2										**07/03/2025**
A	35.2	36.1	35.65	0	0.3	0.15	23	24%	69	38
B	36	36.5	33.25	0.2	1	0.6	20	24%	69	38
C	34.9	35	34.95	0	0.2	0.1	26	24%	69	38
D	38	39.2	38.6	0.3	0.5	0.4	20	24%	69	38
Day 3										**09/03/2025**
A	35	37.3	36.15	0	0	0	22.5	24%	72	39
B	37.1	38.2	37.65	0.5	1.5	1	21	24%	72	39
C	35	37.8	36.4	0.3	0.5	0.4	25	24%	72	39
D	39	39.4	39.2	0	0.2	0.1	19	24%	72	39
Day 4										**11/03/2025**
A	40	40.1	40.05	0	0.2	0.1	24	29%	75	41
B	39.8	40	39.9	0.2	0.9	0.55	26	29%	75	41
C	38	39.2	38.6	0	0.2	0.1	32	29%	75	41
D	39.7	42.2	40.95	0.5	0.8	0.65	28	29%	75	41
Day 5										**12/03/2025.**
A	39	40	39.5	0.1	0.3	0.2	24.5	31%	74	41
B	40.5	41	40.75	0.6	1.5	1.05	28	31%	74	41
C	39	40.2	39.6	0	0	0	30	31%	74	41
D	41.5	42.1	41.8	0.2	0.5	0.35	27.8	31%	74	41

Vanjaravas

Location	Air Temperature			Wind Speed m/s			Humidity	Humidity	NAQI	Temperature
	Min	Max	Average	Min	Max	Average		(from weather station)		
Day 1										**19/03/2025**
A	38.2	39.5	38.85	0.3	0.7	0.5	16.9	19	185	36
B	39.2	39.8	39.5	0.7	1.3	1	16.2	19	185	36
C	39.2	40.2	39.7	0	0.5	0.25	17.5	19	185	36
D	38.5	40	39.25	0	0	0	17	19	185	36
Day 2										**21/03/2025**
A	39.8	40.2	40	0	0	0	17.4	35	195	35
B	38.4	39.9	39.15	0.2	1.4	0.8	18.3	35	195	35
C	40.4	41.2	40.8	0	0.3	0.15	18.9	35	195	35
D	40	40.5	40.25	0	0.2	0.1	19.4	35	195	35
Day 3										**22/03/2025**
A	41.5	42	41.75	0	0.3	0.15	16.4	25	181	36
B	40	40.9	40.45	0.8	1.7	1.25	17.5	25	181	36
C	41.9	42.6	42.25	0	0	0	17.9	25	181	36
D	39.8	40.7	40.25	0	0.4	0.2	18.3	25	181	36
Day 4										**23/03/2025**
A	42	44	43	0	0.5	0.25	14.3	22	191	37
B	39.2	40.6	39.9	0.6	1.4	1	14.9	22	191	37
C	41.4	41.8	41.6	0	0.1	0.05	16.8	22	191	37
D	40.3	42	41.15	0	0	0	17.4	22	191	37
Day 5										**12/03/2025**
A	41.3	42	41.65	0.2	0.4	0.3	17.9	29%	195	35
B	40	40.3	40.15	0.7	0.9	0.8	17.4	29%	195	35
C	39.9	41.2	40.55	0.2	0.3	0.25	19.2	29%	195	35
D	39.2	40	39.6	0.1	0	0.05	18.4	29%	195	35