Technical Consultant:
Tarutium
Global Consulting

Implementation Pathway for Addressing Heat Risks

in Buildings Sector for Identified Hotspots in Mumbai

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Foreword

Dr. Ashwini Joshi IAS
Hon. Additional Municipal Commissioner (City),
Brihanmumbai Municipal Corporation

Mumbai is increasingly experiencing the effects of the climate crisis such as rising temperatures and humidity. Earlier in 2025, the city recorded a temperature of 39.2°C. 6.8 degrees above normal. Such extreme heat, once rare, is now becoming more frequent, and driven by rapid urbanisation, such events put a lot of stress on municipal services. Microclimatic variations across neighbourhoods show the potential of interventions in our built environment to reduce impacts of intensified heat events. Addressing this is not only an environmental concern but essential for public health, safety, and resilience.

This report serves as a guiding strategic document for BMC departments, developers, architects, stakeholders and other regulatory agencies to consider climate parameters in the way we design, construct, and retrofit buildings in Mumbai. As a collective responsibility, we need to consider incorporating passive design, green building norms, and energy-efficient cooling solutions that can reduce the urban heat island effect, improve thermal comfort and build a more climate-resilient city.

I commend the Department of Environment and Climate Change under the leadership of the Deputy Municipal Commissioner, for advancing the strategies outlined in the Mumbai Climate Action Plan (MCAP) and coordinating with wide stakeholders for developing implementable strategies that need to be further piloted and mainstreamed. I extend my sincere appreciation for their commitment and determination in spearheading this important initiative. I also thank C40 Cities, and their technical consultant, for the valuable support and expertise in shaping this pathway.

As we plan and build the future of Mumbai, it is essential that our growth remains inclusive, climate-resilient, and responsive to emerging challenges. Let this serve as a call to action, one that guides Mumbai towards a safer, sustainable, and livable place for all.

Shri. Rajesh Tamhane
Former Hon. Deputy Municipal Commissioner,
Environment and Climate Change department,
Brihanmumbai Municipal Corporation

It gives me great satisfaction to present the Implementation Pathway to Address Heat Risks in the Building Sector. I would like to express my sincere gratitude to the leadership of the Brihanmumbai Municipal Corporation (BMC) for recognising the urgency of climate-responsive action and for enabling the Environment and Climate Change Department to take this work forward meaningfully.

The Environment and Climate Change Department has been steadily working towards the implementation phase of the Mumbai Climate Action Plan (MCAP), and this work builds on its strategies and vision. The department has taken proactive steps to prioritise and operationalise MCAP's sectoral strategies. Given the increasing incidence of heat stress in the city, addressing the identified climate risk of urban heat focused on the building sector in the city was chosen as a priority area requiring further support for urgent action.

This initiative would not have been possible without the active participation of several BMC departments, who contributed valuable insights throughout the consultation process. I also extend my thanks to our key institutional stakeholders, Mumbai Metropolitan Region Development Authority (MMRDA) and Maharashtra Housing and Area Development Authority (MHADA), and also practitioners from the building sector, academic institutions, and domain experts. Your engagement has greatly enriched the direction of this pathway, and we look forward to continued collaboration as we move into implementation. Finally, I am deeply thankful to the C40 Cities and their technical consultant for their expertise, guidance, facilitation of stakeholder consultations and drafting this pathway.

Shri. Avinash Kate
Hon. Deputy Municipal Commissioner,
Environment and Climate Change department,
Brihanmumbai Municipal Corporation

This pathway will serve as a strategic document for the Environment and Climate Change Department to chart the next steps in strengthening Mumbai's heat resilience. Moving forward, coordinated action across departments will be critical to bring such targeted strategies to implementation.

I am confident that this will be a valuable tool not only for government departments but also for private sector stakeholders, developers, and communities committed to a climate resilient development.

Shruti Narayan
Managing Director, Regions and Mayoral Engagement, C40 Cities

Since 2007, Mumbai, a C40 city and India's financial capital, has shown strong climate action leadership despite climate crisis challenges. However, rapid urbanization, deforestation, surface hardening, and rising global temperatures have intensified extreme heat risks. The urban heat island effect drives up energy use, emissions, and air pollution, impacting health. With 13 heatwaves and 2 extreme heatwaves in 30 years, and an average of 8 days annually exceeding threshold temperatures, embedding resilience into the city's fabric is urgent.

This report outlines a heat resilience pathway for Mumbai's building sector, a critical area due to its GHG emissions and impact on citizen health. Building on the Mumbai Climate Action Plan, it identifies heat hotspots and proposes a roadmap to mitigate health impacts from rising temperatures. This includes integrating climate-responsive design and materials into building codes, launching public building retrofits, and aligning institutional responsibilities. The report provides specific interventions and actions for vulnerable populations like outdoor construction workers, aiming to transform heat risk into sustainable urban development. As Mumbai faces more frequent extreme heat events, passive cooling, robust governance, and cross-sector collaboration are vital for public health, productivity, and liveability. This roadmap, developed through hotspot analysis and consultations with municipal departments and stakeholders, signifies a crucial step in this journey.

C40 commends the Brihanmumbai Municipal Corporation for its leadership and commitment to advancing Mumbai’s heat resilience agenda. C40 also appreciates the efforts of technical consultant Tarutium Global Consulting, in creating this pathway which will enable implementation at scale. It is our hope that this report not only accelerates transformative action in Mumbai but also inspires peer cities across India and the Global South to embed climate resilience into their core planning and development processes.

We look forward to supporting Mumbai as it brings this roadmap to life and leads the way in building a cooler, healthier city for all.

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01 Introduction - Urban Heat Risk in Mumbai

Mumbai, India's financial capital and one of the most densely populated megacities in the world, has been facing the impacts of the climate crisis. Among these, urban heat stress is emerging as a growing threat. In 2023 and 2024, the city experienced high temperatures above 39°C during April and May, which was 5 to 6°C above the normal maximum daytime temperature according to India Meteorological Department (IMD). These high temperatures particularly impact vulnerable populations and the built environment. As a C40 member city, Mumbai launched its Mumbai Climate Action Plan (MCAP), which identifies urban heat as a key climate risk in the city among other risks such as urban flooding, landslides, coastal risks, and air pollution.

Urban Heat Island (UHI) effect, is contributing to the escalating localised heat burden in the city. As showcased in the MCAP, some areas were observed to be 6-8°C warmer than the nearby residential zones, which could be attributed to high density construction, low green cover and use of heat-retaining building materials. The choice of building materials and prevailing design practices significantly contribute to indoor and outdoor heat gain. Increased indoor heat raises dependence on mechanical cooling systems such as air conditioners, which further release heat into the environment.

With a population density estimated to be 26,931 persons/km^2 for the year 2023 by BMC, the demand for housing and buildings is expected to further rise. Now how these buildings are built or redeveloped matters. The use of conventional, heat emanating building materials in the constructions, and reduction of green cover will likely exacerbate heat risks. However, this also presents a critical opportunity to promote heat-resilient construction using the right design and material choices, alongside nature-based solutions integrated into building plans. MCAP has outlined sectoral strategies to mainstream heat resilience in the built environment, calling for adaptation measures that reduce exposure, lower vulnerability, and promote thermal comfort for all.

Taking cognisance of this, the Department of Environment and Climate Change, Brihanmumbai Municipal Corporation (BMC) has prioritised interventions to improve heat resilience in the city, with a specific focus on the building sector. This "Implementation pathway to address heat risks in the building sector in identified hotspots" is a step towards translating targets from the MCAP into targeted implementation.

Prepared with Technical Assistance support from C40 Cities and their consultant Tarutium Global Consulting, the pathway showcases a methodology, where a baseline assessment was conducted to identify high heat hotspots in the city. Three hotspots were shortlisted and a ground-truthing survey was done to develop a pathway for retrofitting and new/redeveloped constructions.

The pathway emphasises the importance of considering material choices for different building typologies and how it can be integrated into the city's construction guidelines and approval processes. Adopting an inclusive approach, the pathway recommends guidelines and measures for protecting construction workers during extreme heat - these could be adopted to improve the conditions on construction sites and safeguard workers' health.

This summary document provides an overview of the process and key strategies captured in the pathway.

02 Project Overview

The development of the pathway relied on a robust baseline assessment to understand the overall heat trends in the city over the years and mapping the high heat hotspots. Future projections cited in the MCAP indicate an increase in average daily temperatures by up to 1.5°C by 2050 under a high emissions scenario, with greater frequency of days exceeding 35°C. A comprehensive analysis of Mumbai's temperature trends shows a clear warming trajectory. Between 1994 and 2024, Mumbai's average temperature increased by 0.30°C per decade. The frequency and intensity of heatwaves have risen substantially, with 13 heatwave events and 2 extreme heatwaves recorded in the last 30 years. The average number of days exceeding threshold temperature values has increased to 8 days per year, with 13 years surpassing this average between 1994 and 2023. Notably, 6 of these occurrences have been recorded in the last decade (2014-2023), signaling a clear acceleration in extreme heat events.

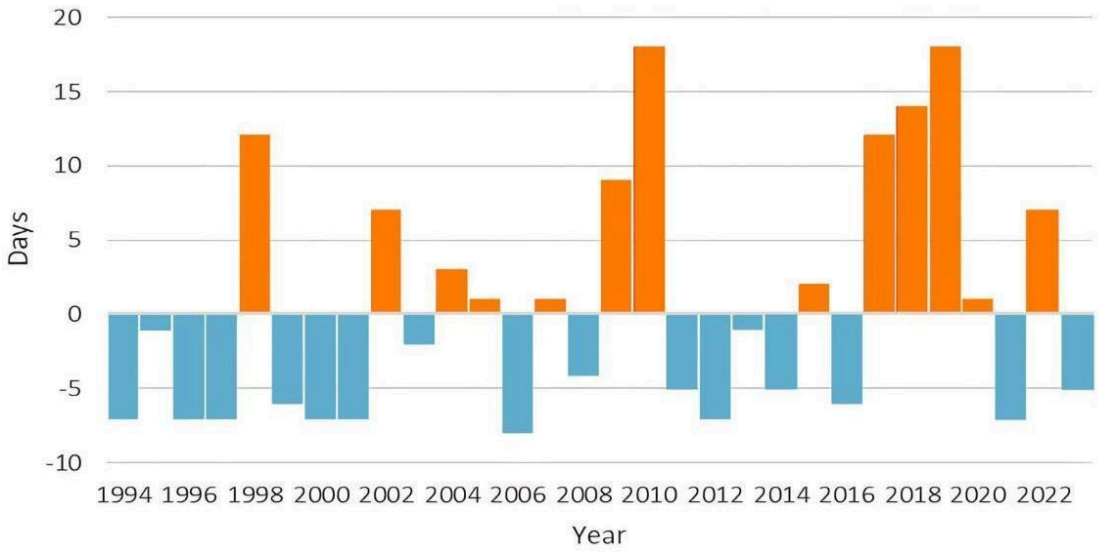


Figure 1: Number of annual hot days; Analysis by Tarutium

According to satellite-based thermal analysis conducted, the city recorded an average Land Surface Temperature (LST) increase of 0.9°C between 2001 and 2021. These are primarily due to high built-up density, limited vegetation, and low Sky View Factor (SVF), which inhibit ventilation and promote heat retention. To further understand the impact on LST due to the built form, the study adopted the Local Climate Zone (LCZ) classification system to assess the urban morphology. LCZ mapping enabled a typology-based analysis considering the urban form and building morphology. This allowed for categorising built-up areas spatially as per their LCZ class such as compact low-rise, compact mid-rise, lightweight low-rise, and dense trees, linking them to heat intensity, laying the foundation for sector-specific interventions. It was observed that over 60% of Mumbai's built-up area shows LST values ranging from 35°C to 42°C during peak summer, showcasing intensifying urban heat islands. Areas with the highest exposure correlate with compact mid-rise building typologies, where shading and airflow are severely limited.

Hence interventions recommended in the pathway focus on strategies to reduce the heat retention of the built environment through passive design interventions to improve ventilation and increase use of cool and reflective materials, reduce solar heat gain through building orientation, shading and increasing vegetation, for the different building typologies.

The study was structured into six interlinked stages, each backed by data, ground-truthing, focused stakeholder consultations and implementable strategies.

Figure 2 Developing an Implementation Pathway for Addressing Heat Risks in the Building Sector

Baseline Assessment:
Local Climate Zone (LCZ) classification and Land Surface Temperature (LST) analysis of the city using Landsat data and locations of the 59 Automated Weather Stations (AWS) data. The data interpolation were used to map surface heat exposure across Mumbai's wards.

Typology analysis and heat hotspot identification:
Based on the high heat locations mapped, three distinct areas were selected based on the diverse urban fabric especially the built typologies. These were Deonar (low-income and industrial), Kandivali (residential and mixed-use), and Kalbadevi/Churchgate area(coastal and commercial). Field assessments were carried out across the three identified hotspot zones to validate the urban morphology, prominent building material characteristics, and surface conditions. Diagnostic parameters such as Sky View Factor (SVF), enclosure quality, typologies, and presence of green cover, ventilation and shading features were captured.

Stakeholder consultations:
Led by the Environment and climate change department, extensive consultations were carried out with relevant BMC departments (over 10 departments), including Building Proposals, Disaster Management, Health and Gardens. Inputs from parastatal bodies such as the Maharashtra Housing and Area Development Authority (MHADA) and the Mumbai Metropolitan Region Development Authority (MMRDA) were consolidated to identify feasible entry points for heat resilience interventions in the building sector. Practitioners from building sector (National Real Estate Development Council (NAREDCO), Confederation of Real Estate Developers' Associations of India - Maharashtra Chamber of Housing Industry (CREDAI-MCHI), etc.), academic institutions and domain experts gave key insights to strengthen the approach.

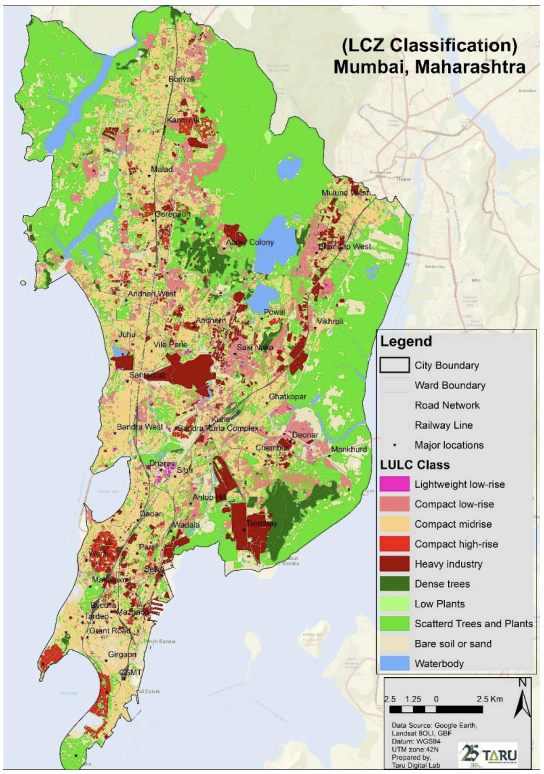
Strategy formulation:
Interventions were developed for retrofitting existing buildings, new development/redevelopment, neighborhood strategies focusing on societies and public spaces, and institutional integration for implementation. The strategies recommends alignment with the existing codes such as Energy Conservation Building Code (ECBC), Eco-Niwas Samhita (ENS) for residential buildings, Development Control and Promotion Regulations (DCPR 2034), green building standards and MCAP sectoral targets.

Implementation pathway:
The pathway was created linking short-, medium-, and long-term actions linking the departmental roles. Some of the initiatives focused on pilot-based cooling and resilience strategies, and policy and institutional level recommendations. The quick-win approaches for the city focus on suggestive guidelines to safeguard outdoor construction workers against extreme heat and on integrating building material recommendations to improve heat resilience.

Image source: Unsplash

03 Baseline Findings and Heat Hotspots Identification

To assess the extent and spatial variation of urban heat across Mumbai's 474 km² area, the satellite-derived Land Surface Temperature (LST) data from summer months (March–June) and Automated Weather Station (AWS) data from 59 active locations were used for the Local Climate Zone (LCZ) classification. The LCZ Framework, adapted from Stewart and Oke (2012), was tailored to Mumbai's urban fabric by consolidating 17 standard classes into 7 built typologies and 4 open space categories, enabling a more granular understanding of heat distribution. It was observed that compact mid-rise typology dominates Mumbai's built-up areas, covering 28.79% of the city and exhibiting high surface temperatures due to dense morphology, low ventilation, and heat-emanating materials. Other significant contributors include bare soil/sand (16.35%), scattered trees (16.16%), and low plant areas (11.23%), each with varying thermal impacts.



Name	LST in °C
Aarey Colony	40.52
Andheri	39.97
Andheri West	39.78
Antop Hill	38.91
Bandra Kurla Complex	38.44
Bandra West	36.88
Bhandup West	41.71
Borivali	38.35
Byculla	38.55
Chembur	38.44
Churchgate	38.21
CSMT	39.29
Dadar	40.14
Deonar	42.07
Dharavi	41.44
Ghatkopar	38.47
Girgaon	39.7
Goregaon	39.91
Grant Road	39.28
Juhu	37.18
Kandivali	40.27
Kemps Corner	37.05
Kurla	41.22
Mahalaxmi	38.01
Malabar Hills	34.75
Malad	38.59
Mankhurd	40.04
Mazgaon	39.7
Mulund West	38.5
Mumbai Central	38.45
Navy Nagar Colaba	36.12
Parel	38.11
Powai	37.91
Saki Naka	42.02
Santacruz	37.81
Sewri	40.97
Sion	38.51
Tardeo	37.55
Trombay	42.21
Vikhroli	40.22
Vile Parle	37.2
Wadala	39.82
Worli	40

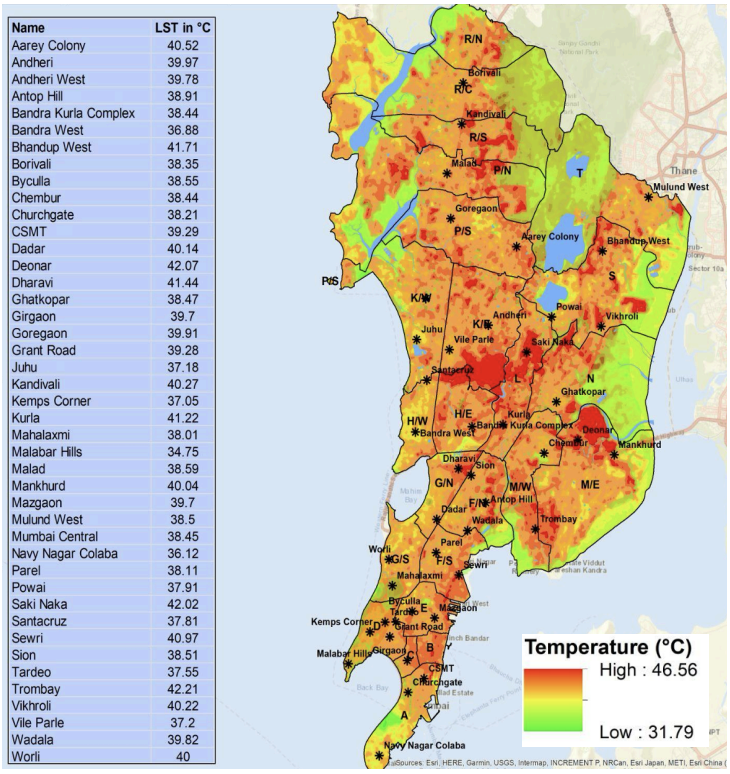


Figure 3: LCZ classification and building typologies; Spatial Distribution of Heat Stress (LST), summer 2024

Based on this analysis, some of the identified heat hotspots in the city include Deonar, Govandi East, Vikhroli West, Byculla, Dadar, Bandra, Matunga, Mulund West, Bhandup West, Malad West, Kandivali West, CSMT, Santacruz, and Dharavi. All these areas exhibited a very high LST of over 36°C, some even exceeding 40°C. From these, Deonar, Churchgate and Kalbadevi, and Kandivali were shortlisted and selected as representative areas for detailed assessment. This selection was based on their prominence in the spatial heat mapping analysis and their distinct LCZ characteristics (e.g., low-rise, compact high-rise, mid-rise or a mix), which allows for the comparison of how different building typologies influence localised heating.

To complement the citywide LCZ-based analysis, detailed field assessments were conducted in the three shortlisted hotspot zones to validate and complement spatial analysis outputs using the following indicators:

- **Sky View Factor (SVF)**: values less than 0.35 indicated poor radiative cooling, and more than 0.5 suggested openness to the sky
- **Enclosure quality ratio**: compact built forms with high wall-to-height (H/W) ratios (H/W ≥ 1.5 - 2:1) signifies intensified heat retention, and H/W≤ 0.5:1 has low heat retention but high solar exposure. The optimal ratio is not fixed since it is a dynamic parameter that depends on the climate and specific thermal goals.
- **Vegetative Cover**: a Normalized Difference Vegetation Index (NDVI) < 0.1 indicating minimal evapotranspiration, and ≥ 0.3 reflecting effective greenery presence
- **Building orientation and height**
- Use of **heat-retaining materials**

Deonar: The area is predominantly hosting a mix of informal housing, industrial, and waste management infrastructure. SVF analysis revealed low sky visibility (<0.3 in dense pockets), indicating limited radiative heat dissipation. Ground observations confirmed high heat retention due to exposed concrete surfaces and minimal vegetation cover. NDVI readings were particularly low in the eastern segments, underscoring urgent greening potential

Kandivali: This zone features a residential and commercial mix with high imperviousness. Rooftop solar exposure is high, and SVF values ranged from 0.4–0.6, depending on building setbacks and internal courtyards. Field measurements showed elevated ambient air temperatures in narrow lanes and hotspots on hard paved surfaces. NDVI was moderate, and residents reported intense indoor heat during afternoons—pointing to opportunities for rooftop retrofits and enhanced shading

Churchgate and Kalbadevi: This institutional zone largely has compact midrise and high-rise typologies. It benefits from ventilation corridors due to its coastal orientation, yet SVF values were highly variable ranging from as low as 0.2 in shaded alleyways to >0.7 in open areas. While tree-lined roads offered some thermal comfort, surface temperature scans revealed intense ground-level heat stress in high albedo zones, particularly where stone paving dominates. This underscores the need for pedestrian-level shading and surface material improvements.

The survey aimed to capture localised vulnerabilities and assess the level of thermal comfort. Insights from the exercise provided key evidence for prioritising retrofitting and planning interventions aligned with the broader implementation pathway to address heat risks in the building sector.

The ground-truthing exercise validated the LCZ Classification Framework. For example, Deonar mostly showcased mid-rise compact typology and informal settlements with poor ventilation, characterised by narrow alleys and tightly packed structures made of heat-absorbing materials. Such on-ground condition assessment provides evidence for location-specific strategies for mitigating the heat hotspots.

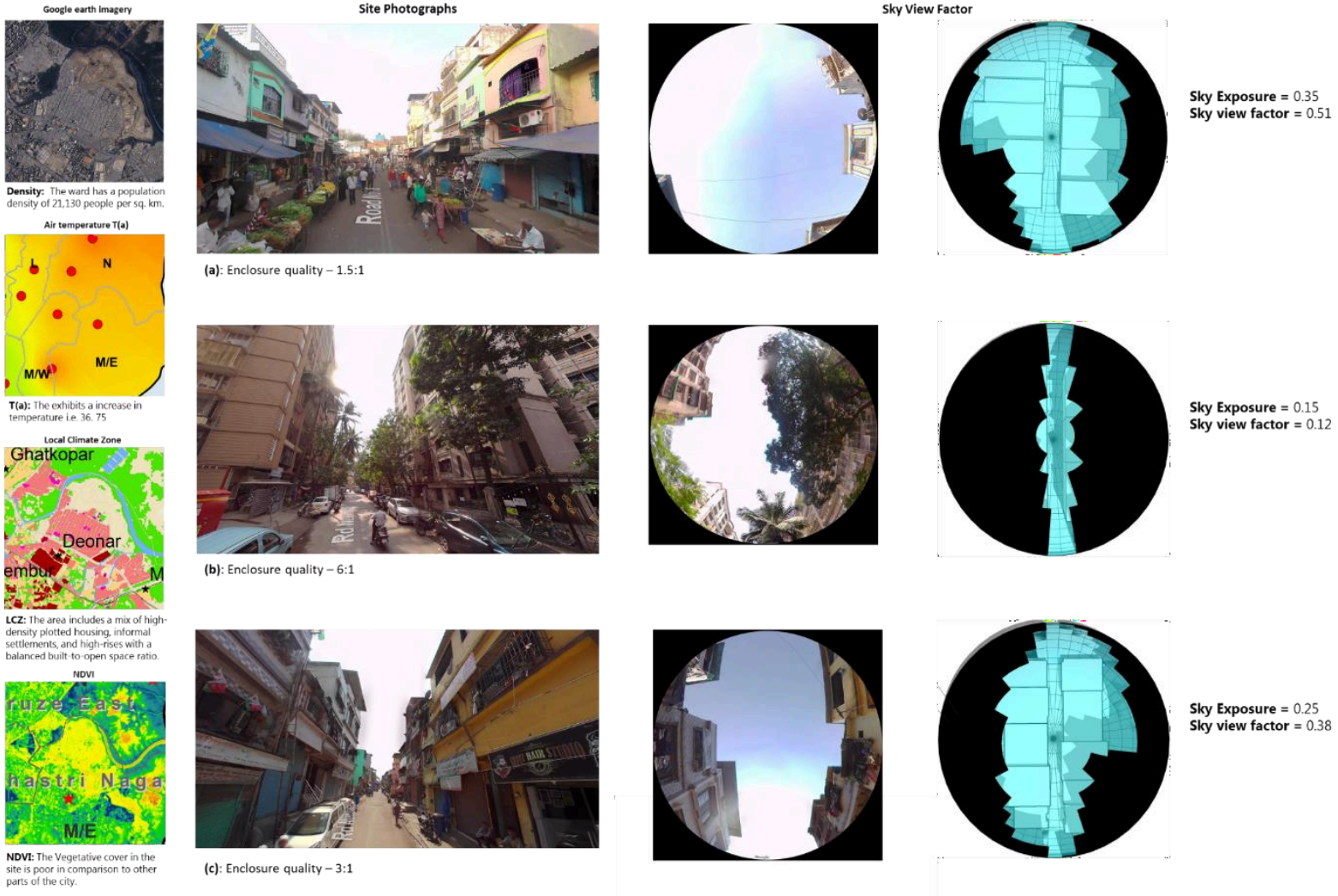


Figure 4 Deonar: Sky View Factor and Enclosure Quality Observation

04 Approach for heat resilience in Mumbai's building sector

After assessing the prominent and diverse building typologies across the three selected heat hotspots, it was important to adopt an approach that considers the existing building stock and the new developments that are being planned or underway. Considering the city's existing stock of more than 2 lakh buildings (residential, commercial, industries and mix use), targeting the retrofitting potential of existing structures is essential. Prioritising retrofitting as an initial step, and simultaneously developing regulations to guide the new development / redevelopment offers a scalable strategy.

- **Retrofitting existing buildings**: This lever focuses on upgrading the thermal performance of the existing buildings, by first piloting the interventions on BMC-owned buildings (schools, ward offices, and health facilities). Recommended interventions include application of cool roof systems with high solar reflectance index (SRI ≥ 0.75), use of retro-reflective exterior coatings, green roofs and walls in feasible locations, and improved natural ventilation strategies. Results from pilot retrofits can influence material specifications for heat resilience in BMC's procurement guidelines and construction approval processes.

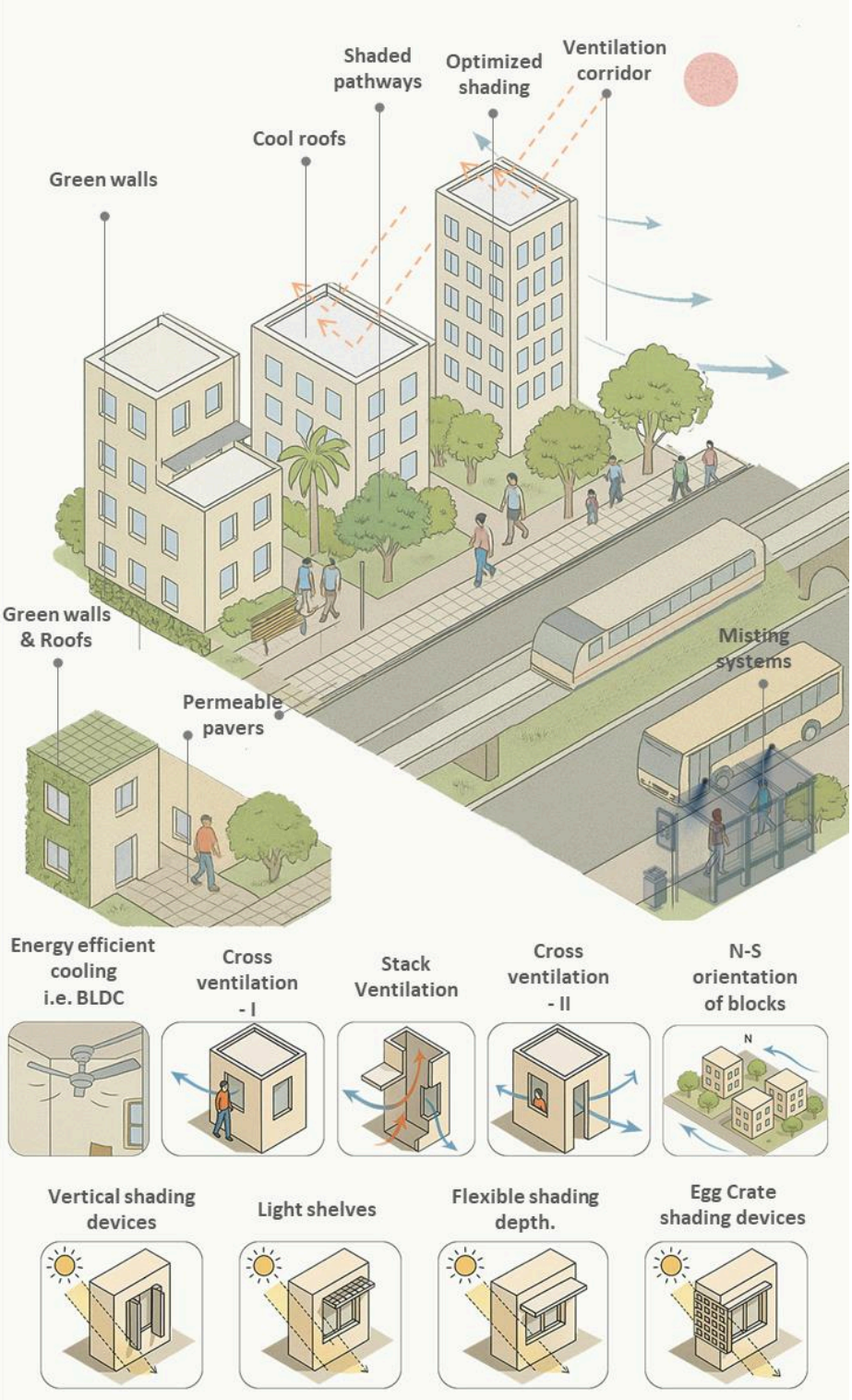
- **Integrating design and material choices in new / redevelopment buildings:** While new building constructions are being planned in the heat hotspots, it is important to consider the location-specific building orientation, factoring in adequate Sky-View Factor (≥ 0.35 in dense residential areas), integrating shading devices into building facades, using permeable and high-albedo paving materials, increasing green cover, and adopting passive design strategies.

  A practical starting point would be to mandate that all new municipal buildings, and retrofits of existing ones, adhere to ECBC performance benchmarks or obtain Green Building certifications such as IGBC or GRIHA. This would help improve thermal comfort while lowering the load on active cooling systems. The uptake of such benchmarks and heat-resilient design and materials by municipal buildings would move the pace of adoption for other non-municipal buildings. The Environment and Climate Change department can take the lead in mainstreaming these requirements in the building plan and construction approval processes. BMC departments can also work with parastatal and state-level planning bodies to influence any heat resilient mandates that can be reflected in any future amendments to the Development Control and Promotion Regulation (DCPR).

- **Material and Surface Treatments at neighbour-hood level:** This lever focuses on mitigating the Urban Heat Island (UHI) and improving thermal comfort in public spaces, particularly in dense, mixed-use and transit-oriented zones through a combination of material interventions and neighborhood-scale passive cooling. Drawing on SVF analysis, wind corridor mapping, and surface temperature diagnostics, proposed actions include the use of high-albedo materials for pavements and rooftops, integration of porous and permeable paving solutions, and expansion of green cover. Installation of streetscapes providing comfort from heat, shading especially near markets and public transit stations where pedestrian footfall is higher, and avenue footpaths can be prioritised for these interventions.

- **Institutional integration of heat mitigation**: To ensure long-term operationalisation, the governance structure for heat actions can be anchored by BMC's Environment and Climate Change Department. While the study does not propose a new

institutional body, it recommends strengthening departmental priorities, master plans, building by-laws and construction-related processes towards focus on heat. Heat is an inter-departmental subject and along with the responsibility for taking actions. The nodal department can coordinate cross-departmental implementation, conducting heat risk screening for capital projects, and embedding heat thresholds into project design and development planning. Departmental budgets can also be allocated for targeted heat resilience and adaptation initiatives.



05 Implementation Pathways: Translating Strategy into Action

The success of this implementation pathway hinges on coordinated municipal action, supported by clear roles, inter-departmental collaboration, and institutionalization of heat-responsive practices. BMC is positioned to lead this effort through the Environment and Climate Change department (anchoring the departmental coordination and advocating heat-resilient pilots and implementation). Other departments can systematically align new building constructions and existing building retrofit projects with the ECBC and green building rating standards, and also collaborate on piloting innovative heat resilience measures in hotspots. Beyond the municipal departments, collaboration with key parastatal bodies like the Maharashtra Housing and Area Development Authority (MHADA) and the Mumbai Metropolitan Region Development Authority (MMRDA) will also be critical to strengthen planning, mobilise resources, and scale up interventions citywide.

Some of the priority actions that the city can follow are mapped as short-, medium- and long-term strategies along with the potential departments that can lead, coordinate for and adopt these strategies.

Short term actions (0-2 years):

Strategies	Potential Departments involved
Pilot UHI Mitigation and Retrofit Projects in selected Heat Hotspots: Implement projects like cool roofs and green roofs/walls in feasible BMC-owned structures (e.g. Schools, Ward offices, health clinics) of the Hotspot location	**BMC:** Environment & Climate Change, School Infrastructure Cell, and Education department, Health Infrastructure Cell and Health department (for healthcare centres), City Engineer, Building Maintenance, Building Construction, Ward offices **Other agencies:** MHADA (for mass public housing), Slum Rehabilitation Authority (SRA)
Mandatory compliance of ECBC and green building norms: Ensure all new and redevelopment municipal buildings, and retrofitting of existing ones, comply with ECBC/ENS or has Green Building Certification by authorised bodies such as IGBC or GRIHA.	**BMC:** Environment & Climate Change, Building Proposals, Mechanical & Electrical, City Engineer, Ward offices **Other agencies:** Maharashtra Energy Development Agency (MEDA) (for ECBC adoption), State Public Works Department (PWD)
Sky View Factor (SVF) Mapping: Conduct citywide audits using remote sensing & ground surveys to identify low-SVF zones and to implement heat resilient actions such as possible greening and targeted ventilation strategies.	**BMC:** Development Planning, Environment & Climate Change, Garden, Building Proposal **Other agencies:** MMRDA, Academic and Research Institutions
Wind Corridor Mapping: Micro-climatic analysis & Computational Fluid Dynamics (CFD) modelling in selected heat hotspots to identify airflow bottlenecks. Propose small-scale urban design improvements - such as opening up ventilation pathways and reorienting future developments.	**BMC:** Development Planning, Environment & Climate Change, Building Proposal **Other agencies:** MMRDA, Academic and Research Institutions, Domain experts
Policy intervention: Integrate passive design elements into BMC's building guidelines for municipal buildings. As an immediate step issue internal design circulars or model building examples for reference for compliance.	**BMC:** Environment & Climate Change, Building Proposals, City Engineer, Development Planning

Medium term actions (2-5 years):

Strategies	Potential Departments involved
Scale-up ECBC and Green Building compliance: Mandate phased compliance with ECBC/ENS & obtain Green Building certification (e.g., GRIHA, IGBC) for all new municipal, institutional, and large private developments/redevelopments. Ensure adherence to energy efficiency, resource conservation, and passive design strategies.	**BMC:** Environment & Climate Change, Building Proposal, Development Planning, City Engineer, Mechanical & Electrical **Other agencies:** MEDA, Bureau of Energy Efficiency (BEE), IGBC, GRIHA Council, For adoption – National Real Estate Development Council (NAREDCO), Practicing Engineers, Architects and Town Planners Association (PEATA), Confederation of Real Estate Developers' Associations of India - Maharashtra Chamber of Housing Industry (CREDAI-MCHI)
Scale-up Pilot Demonstration Projects: Expand retrofits to key buildings in hotspots, including in dense chawls and informal settlements through BMC-led or community-led approaches.	**BMC:** Environment & Climate Change, Ward Offices, Health Infrastructure Cell **Other agencies:** MHADA, SRA, CSR-led platforms, NGOs and Community-Based Organisations, Academic Institutions
Capacity building: Develop a structured capacity building program for BMC engineers, architects, building inspectors, and ward-level officials on heat-resilient construction practices—including ECBC compliance, passive design, green building norms, and heat vulnerability assessment.	**BMC:** Environment & Climate Change, Ward Offices, Building Proposal **Other agencies:** MEDA, IGBC, GRIHA, Academic Institutions, domain experts
Incentivise Heat-Resilient Construction and Retrofits: Targeted incentives including property tax rebates, fast-track building approvals, or additional Floor Space Index (FSI) for projects that incorporate green building certification, ECBC compliance, cool roofs, passive ventilation, or nature-based design elements.	**BMC:** Environment & Climate Change, Assessment and Collection, Building Proposal **Other agencies:** GRIHA / IGBC, CREDAI-MCHI/ PEATA/ NAREDCO (to promote uptake), State Urban Development Department

Long-term actions (5-7 years):

Strategies	Potential Departments involved
Mainstream Heat-Resilient Urban Planning: Integrate heat resilience in urban planning framework - DP revisions, Local Area Plans and suggestions to DCPR amendments.	**BMC:** Development Planning, Environment & Climate Change, Building Proposal **Other agencies:** MMRDA, State Urban Development Department
Integrate Heat Criteria into Building Plan Approvals: Update the Building Plan approval documents or Portal, and Schedule of Rates, to include ECBC checklists, passive design assessment, building material compliance, SVF or ventilation guidelines	**BMC:** Building Proposal, Development Planning

Strategies	Potential Departments involved
Mandatory Climate Thresholds for Infrastructure Projects: Link new infrastructure (e.g., roads, Housing, Power infrastructures, etc) with heat-resilience thresholds; Eg., recommending a minimum percent of reflective materials for road resurfacing projects, implementing nature-based solutions into road and housing layouts, or requiring a microclimate impact assessment before approving large-scale housing developments.	**BMC:** Environment & Climate Change, Roads and Traffic, Building Proposal, Development Planning, City Engineer, Stormwater Drainage **Other agencies:** MMRDA, PWD, State Urban Development Department
Green Space belts in the city: Establish an interconnected network of green space belts through rooftop gardens, greener societies, tree-lined streets, and vertical gardening. These interventions should focus on creating ecological corridors, improving thermal comfort, and promoting biodiversity in high-dense urban zones.	**BMC:** Garden, Development Planning, Roads and Traffic **Other agencies:** MMRDA, Forest department, Housing Societies, RWAs, and NGOs, CSR platforms
Strengthen collaborations for financing and implementation: Enhance collaboration with state and national climate programmes and international climate finance bodies to secure sustained funding and technical assistance for implementing heat resilience and broader climate adaptation projects in Mumbai. Eg.: National Adaptation Fund, Green Climate Fund (GCF), multilateral development banks, etc., to support infrastructure retrofits, nature-based solutions, and community resilience efforts.	**BMC:** Environment & Climate Change **Other agencies:** State Ministry of Environment and Climate Change, National Ministry of Housing and Urban Affairs (MoHUA), Ministry of Environment, Forest and Climate Change (MoEFCC)

Quick-win measures for BMC:

1. **Guidelines for safeguarding outdoor construction workers from extreme heat**

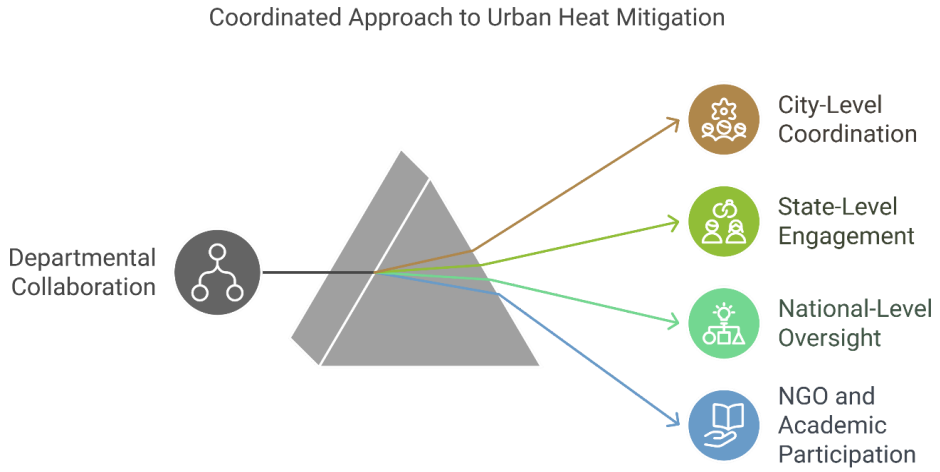
Outdoor construction workers in Mumbai are highly vulnerable to extreme heat due to prolonged exposure and inadequate protection measures. To safeguard their health, the guidelines aim to safeguard outdoor construction workers in Mumbai from rising heat risks through practical, inclusive, and enforceable measures. They address key challenges such as prolonged exposure to high temperatures, lack of hydration and shaded rest areas, economic pressures, and gender-specific vulnerabilities. Drawing on international standards like those from the International Labour Organization (ILO) and Building and Other Construction Workers (BOCW) Act, the guidelines recommend work-rest cycles, hydration protocols, first-aid preparedness, and employer responsibilities including PPE, training, and flexible scheduling. A user-mapping outlines roles for employers, site managers, health personnel, and workers, emphasizing awareness, accountability, and coordinated implementation to reduce occupational heat stress and promote safer working environments citywide.

2. **Recommendations to integrate heat-resilient building materials and construction practices in Schedule of Rates and approval processes:**

In response to Mumbai's escalating heat vulnerability, the analysis examines the building material codes under DCPR-2034 and the Schedule of Rates (SOR), revealing a significant regulatory gap. While current guidelines ensure structural safety and certain design parameters, they do not mandate the use of heat-reflective and energy-efficient materials critical for UHI mitigation. Analysis across diverse building typologies in the city shows that conventional materials like concrete, asphalt, and corrugated metal exacerbate heat absorption and hinder radiative cooling. Drawing on global best practices, recommendations have been provided to integrate high-albedo coatings, advanced thermal insulation (including phase-change materials), and sustainable green and blue infrastructure (such as green roofs, vertical gardens, and permeable pavements) into the regulatory framework. Updating the SOR and developing building approval checks for the type of material used and design process followed, are essential steps toward reducing thermal stress, lowering energy consumption, and enhancing indoor comfort across Mumbai. The city can also work with the state authorities in amending the DCPR to include specific thermal performance thresholds.

06 Systemic Impact and Institutional Integration

The successful implementation of the pathway requires robust coordination mechanisms, clearly defined stakeholder roles, and institutional capacity to operationalise interventions across scales.



- **City-Level Coordination and Departmental Collaboration**

  BMC's Environment & Climate Change Department is positioned to lead the heat resilience agenda, leveraging its existing role in implementing the Mumbai Climate Action Plan. To ensure city-wide impact, the department will need to coordinate with Development Planning, Building Proposals, Building Construction, Disaster Management, Health, and Gardens departments to harmonise planning and execution. Monthly inter-departmental meetings and a heat resilience implementation matrix are recommended to track implementation and ensure accountability.

  The Disaster Management Department will play a critical support role by strengthening early warning systems, heatwave surveillance, and issuing timely public advisories in coordination with the IMD and Health Department. Additionally, integrating heat action responses into the city's disaster management protocols will be key to reducing heat-related health risks.

- **State-Level Alignment**:

  The Maharashtra Environment and Climate Change Department, State Climate Action Cell, Urban Development Department, and Public Health Department can support BMC by:

  - Issuing technical standards and regional benchmarks for urban heat risk management
  - Enabling state-wide learning platforms and funding channels for city-led pilots
  - Supporting updates to planning regulations (e.g., DCPRs) that integrate passive design and climate-responsive development

  This partnership can help scale best practices from Mumbai to other urban centres in Maharashtra.

- **National-Level Policy Integration:**

  National ministries such as the Ministry of Environment, Forest and Climate Change (MoEFCC), Ministry of Housing and Urban Affairs (MoHUA) provide overarching policy frameworks, technical tools, and climate finance pathways. Mumbai can benefit from leveraging schemes such as AMRUT 2.0, National Cooling Action Plan (NCAP), and National Adaptation Fund for Climate Change (NAFCC). Exploring convergence with Mission LiFE, ECBC/ENS mandates, and other sustainability-linked infrastructure programmes could also be beneficial.

- **Non-Governmental and Academic Participation**

  To ensure inclusive and ground-level impact, active collaboration with NGOs, community organisations, academic institutions, and professional associations (e.g., CREDAI-MCHI, PEATA, IGBC, GRIHA Council) is critical. These partners can:

  - Support pilot implementation, especially in informal settlements and mass housing clusters
  - Lead public engagement and awareness campaigns, particularly targeting heat-vulnerable populations,
  - Contribute to research, impact assessment, and evidence-building for adaptive planning,
  - Provide training and technical assistance for local contractors, workers, and municipal staff.

- **Capacity Building and Knowledge Exchange**

  To enable institutional transformation, the report recommends:
  - Establishing focal points within departments such as Health, Education, Transport, and Disaster Management to integrate heat mitigation into sectoral operations
  - Institutionalising regular training programmes with institutions like MEDA, academic partners, certification bodies like IGBC and GRIHA, and domain expert organisations
  - Facilitating peer-to-peer learning with other cities through technical dialogues, case exchanges, and collaborative projects under platforms such as C40

This collaborative framework ensures that UHI mitigation becomes embedded in everyday governance, with dedicated institutional structures, performance monitoring, and a shared vision across municipal, state, and national actors.

07 Conclusion and Call to Action

The implementation pathway to address heat risks in Mumbai's building sector offers a critical learning: urban heat is not only a technical challenge but a governance and equity issue. The process of mapping hotspots, identifying building vulnerabilities, and engaging diverse stakeholders has highlighted that solutions must go beyond one-time fixes or sectoral silos. They require a shift in how the city plans, builds, and collaborates especially in dense, evolving urban environments like Mumbai. The consultations with stakeholders from the builders and developers associations, and urban development practitioners was one of the key strengths in this process to understand the criticality of practical and feasible implementation steps that the city and the implementers can take.

Mumbai must prioritise pilot projects to generate concrete data and build momentum. These early interventions should focus on retrofitting critical municipal buildings and public housing structures, especially in the city's hottest zones. The success of these pilots will then inform broader policy revisions and guide large-scale demonstration projects in high-density mixed-use areas and redevelopment zones.

For BMC, this pathway reinforces the value of:

- Data-driven decision-making that connects climate science with neighbourhood realities on ground
- Institutional coherence across planning, engineering, health, and environment departments
- A people-centric lens where protecting the most exposed communities becomes central to infrastructure and building design

The pace of urban development presents a window of opportunity. By embedding heat resilience in buildings and construction, Mumbai can set a precedent for adaptive, and inclusive urban development in the face of a warming future.

The call to action is therefore not just implementing these recommendations, but to think strategically hereon how every plan, action and approval becomes a step towards cooler, safer and a healthier urban future.

A Moment for Mumbai: From Planning to Practice

As climate risks intensify, Mumbai stands at a pivotal juncture. The groundwork has been laid, from diagnostic mapping to actionable levers and institutional pathways. What follows next is critical: execution with urgency, scale, and integrity.

By institutionalising heat resilience across departmental priorities, development codes, and infrastructure investments, BMC has the opportunity to transform this strategy to scale up within and across the states. With committed leadership, cross-sector partnerships, and public engagement, the city can deliver on its climate mandate while improving lives.

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