BEAT THE HEAT

Urban India is a heat trap, but road directions, building materials and zone-specific master plans can drastically enhance thermal comfort

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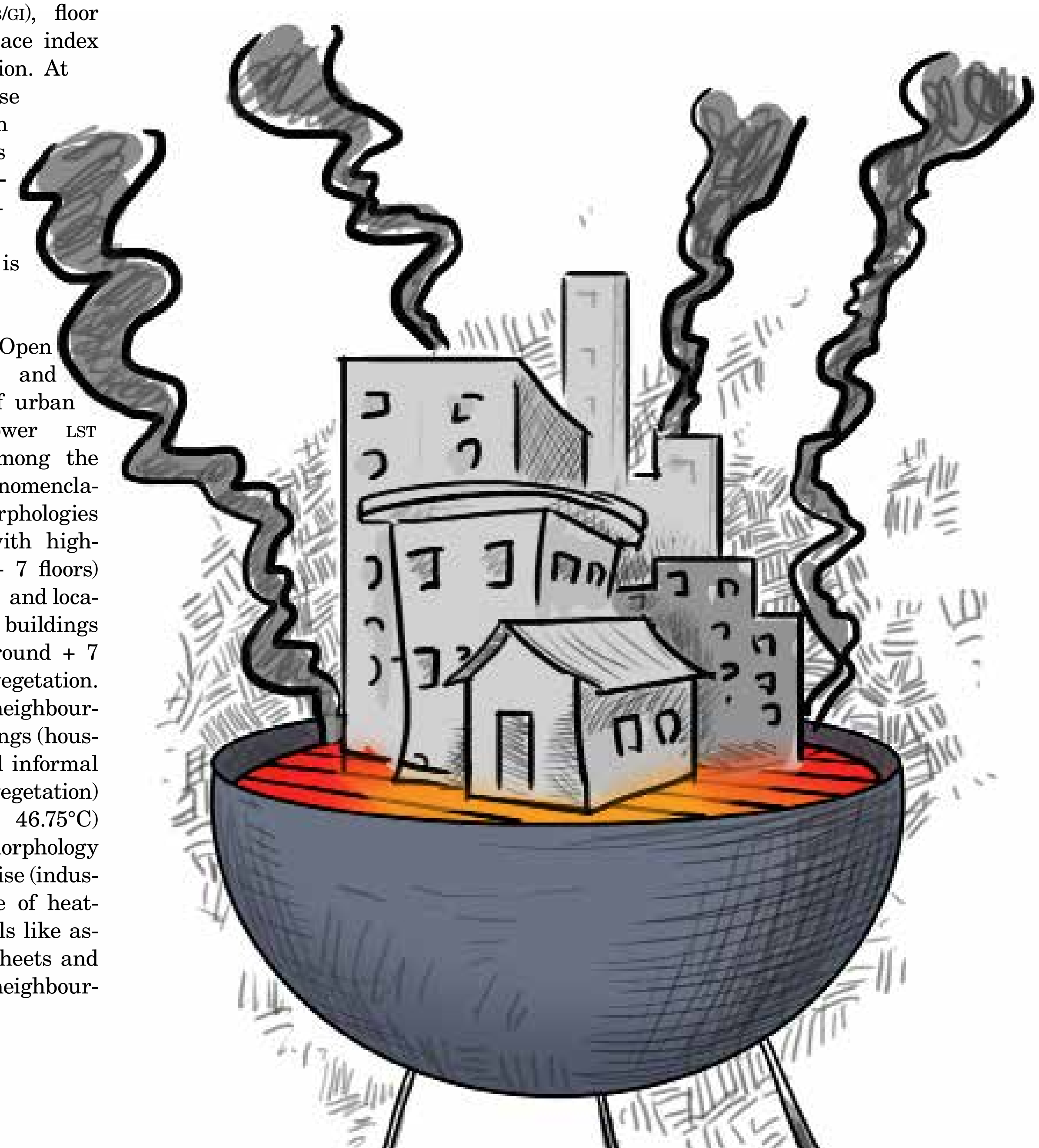
RISING EPISODES and increasing intensity of heatwaves has become quite common and a major problem in Indian cities. The threat is twofold: big cities are finding it difficult to adjust to the changing climate and need liveability improvements. Small cities, on the other hand, are on the brink of explosive growth and require "heat-proof" development. While big cities need retrofits, small cities need heat-resilient master plans and by-laws.

Every city has a unique combination of natural and human-made infrastructure and the activities resulting from them. Closely packed buildings, for instance, will generate shorter trips, hence lesser vehicular emissions that pollute the air and traps the heat. More greenery and waterbodies will sequester carbon emissions and cool down the ambient environment. These combinations of heat and cold sources is called the urban form of a city which plays a crucial role in heat resilience and liveability.

In 2022, Delhi-based non-profit Centre for Science and Environment began a study to understand how different urban forms react to heat. The study, which covers 10 cities, including Pune, Delhi, Kolkata, Bengaluru and Jaipur, is ongoing. But data and trends evident from the study so far suggest steps that could help urban India fight heat.

Urban form can be broken down into and understood through physical parameters. Its key parameters include urban morphology, aspect ratio, sky view factor (SVF), blue/green infrastructure (B/GI), floor area ratio (FAR)/ floor space index (FSI), and street orientation. At Pune, CSE recorded these parameters at more than 90 locations identified as the city's "heat pockets"—locations where land surface temperature (LST) soar above 45°C. This is what the readings show:

Urban morphology: Open highrise, open midrise and compact midrise type of urban morphologies have lower LST (41.29°C to 42.73°C) among the "heat pockets". As the nomenclature suggest, these morphologies denote neighborhoods with highrise buildings (ground + 7 floors) and moderate vegetation; and locations with midrise buildings (ground + 3 floors to ground + 7 floors) and moderate vegetation. The study finds that neighbourhoods with lowrise buildings (housing, industrial areas and informal settlements with sparse vegetation) have 2-4°C (45.26°C to 46.75°C) higher LST. The worst morphology turns out to be large lowrise (industrial) mainly due to use of heat-trapping roofing materials like asbestos, galvanised iron sheets and plastic sheets. Such neighbourhoods can benefit by using better roof materials, reflective paints, cool roofs and green roofs.



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Aspect Ratio: The ratio of building height and street width plays a role in how much heat will be trapped by the roads, pavements and building surfaces. This is linked to the degree of direct sun exposure and is called aspect ratio. The study shows that the higher the aspect ratio, the lower the LST. This means the narrower the street, the lesser the heat gain. Buildings shade each other and decrease direct exposure of surfaces to the sun. Reduction of aspect ratio from 2 to 1 showed an increase in LST from 40°C to 46°C.

Sky View Factor: On a street, the sky visible from a point on the ground and between the buildings can determine how much heat will be trapped and dissipated by the surfaces. This is called sky view factor which lies between 0 to 1. Value 1 means there is none to negligible enclosure. The CSE study finds that SVF value from 0.2 to 0.9 raises LST by a whopping 10°C. Higher SVF locations include highways, road intersections and open parking lots.

Blue/green infrastructure: Greens play a crucial role in enhancing microclimate of an urban area. They regulate temperature and relative humidity, absorb and decompose pollutants, improve the overall air quality and offer shade among other benefits. However the benefits vary widely depending on the kind of greens—grass, shrubs or trees with thick foliage.

Singapore's Green Mark Criteria for Residential Buildings provides a methodology to calculate effective vegetation cover (EVC) to reduce urban heat island effect and conserve natural resources. In this, green areas covered by trees are given the highest weightage, followed by grass and finally shrubs.

The CSE study finds that a 30 per cent rise in EVC reduces LST by 2°C to 4°C. EVC is better in trees with canopy. LST under trees with thick foliage is about 10°C cooler than LST under palm trees in the same locality. Cities usually define the minimum extent of mandatory greens (30 per cent) in master plans and do not provide mandate for the kind of greens. This should change.

Floor Space Index: Cities define the extent of construction on a plot through FSI/FAR. High FST/FAR denotes high built-footprint, which means either tall buildings or closely packed buildings of moderate height. CSE's study suggest that LST decreases as FSI increases. The range of FSI in Pune (100-300) resulted in an LST range of 51°C-40°C.

Street Orientation: The direction in which a street is oriented has a role in heat gain due to sun exposure and wind speed. This affects the outdoor as well as indoor thermal comfort. CSE's study finds that streets oriented along the north-south axis have an LST higher by 1°C as compared to streets along the east-west axis. This is because the streets in north-south orientation are more exposed to the sun. This gives a clear guideline on how to orient streets in new developmental plans.

NEIGHBOURHOOD PLAN

Urban form-based codes can provide contextual cooling solutions to cities. Such codes can address the unique features of a city or even a neighbourhood. Different urban forms could have different zoning regulations with contextual cooling solutions. For instance, an old market could have tree-shaded walkways, a temple precinct could have cool roofs and a business district could have a high EVC (around 30 per cent). Cities need to amend their building by-laws and master plans. In case of Pune, sky view factor, aspect ration, effective vegetation cover and urban morphology are the major drivers affecting heat gain. Other cities can have other drivers and should plan new development accordingly. A 1°C fall in ambient temperature can lead to 2 per cent reduction in the city's power bill. @down2earthindia

~~THE OCCURRENCE OF THE FUJIWHARA EFFECT MAKES CYCLONES MORE UNPREDICTABLE DUE TO RAPID INTENSIFICATION, CARRYING OF MORE RAIN AND MOVING IN NEW WAYS OVER WARMING OCEANS~~