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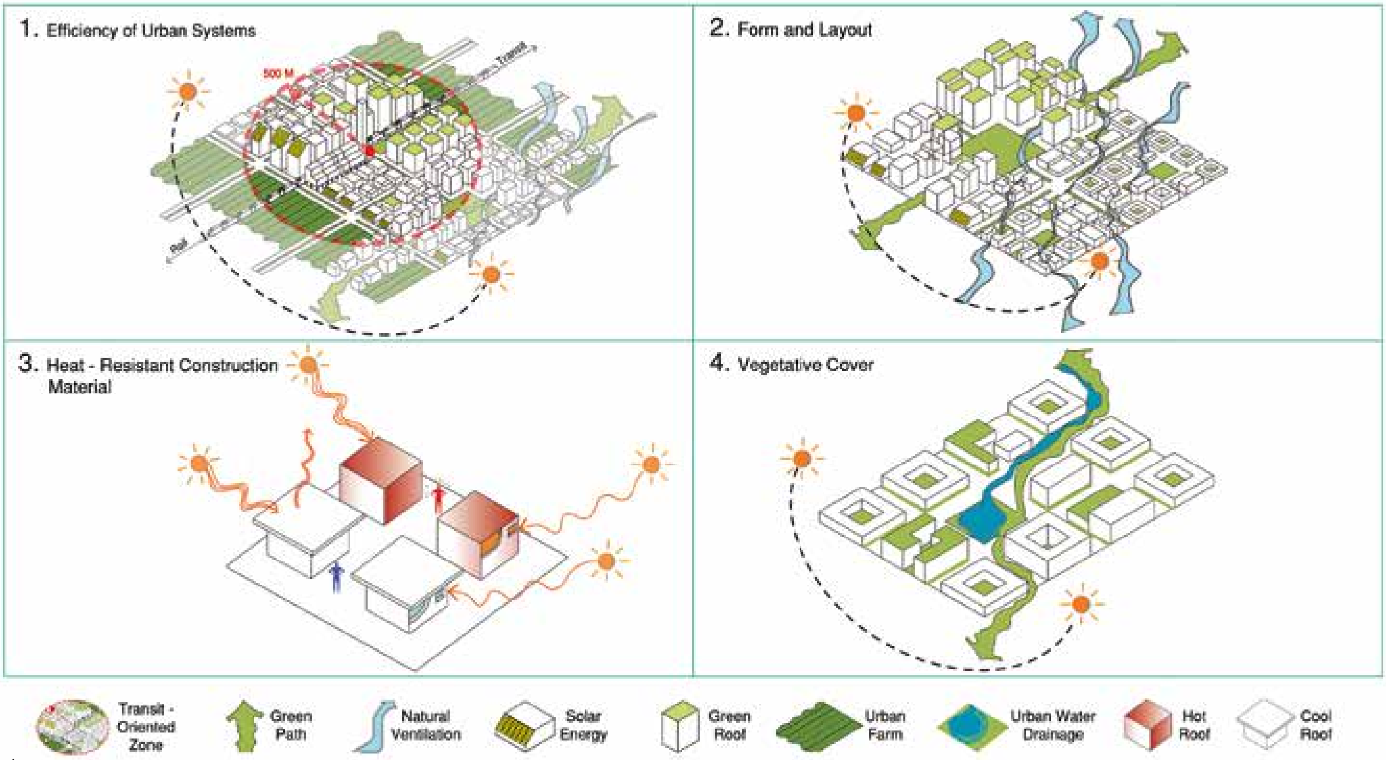
URBAN DESIGN

Winter 2019
Urban Design Group Journal
ISSN 1750 712X

URBAN DESIGN & CLIMATE CHANGE

URBAN DESIGN GROUP



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From Climate Science to Design Practice

Jeffrey Raven offers principles and ideas on phasing and participation to deal with climate change

The timing of this issue on urban design and climate is critical. The science is clear: action is needed urgently. Confronting the challenges of a rapidly urbanising world threatened by climate change demands an expansion of the traditional influence and capabilities of urban planning and urban design, and requires us to collaborate with policymakers, scientists, technical specialists and key stakeholders. The climate-responsive urban design factors outlined here were developed with global cross-sectoral experts to make climate science 'actionable' through a suite of urban form and function strategies which integrate climate mitigation and climate adaptation together, highlighting the need to reduce waste and greenhouse gas emissions through energy efficiency, transit access and walkability; modify the form and layout of buildings and urban districts; use heat-resistant construction materials and reflective surface coatings; and increase vegetative cover.

More efficient urban systems are vital for reducing anthropogenic (human-caused) emissions from polluting vehicles, industry and construction, and waste heat from buildings. Two-thirds of the world's population is expected to live in cities by 2050 and most of the urban spaces that these individuals will inhabit have yet to be designed. The decisions we make today will have extraordinary consequences on our climate for generations, and we must maximise the efficiency of the urban systems that we are building. This means investing in transit-oriented development, urban design that minimises the need for heating and cooling, efficient storage and management of rainwater, and high energy efficiency standards for buildings, for example.

1 Urban Climate Factors
– Efficiency of urban systems
– Form and Layout
– Heat-resistant construction materials
– Vegetative Cover
Source: J. Raven

FORM AND LAYOUT

Compact urban form produces lower per capita emissions, as compact cities tend to offer better access to public transport, have greater energy efficiency, and lower environmental costs for infrastructure. Conversely, suburban sprawl extends the urban footprint across the region, increases intra-urban distances and costs more to service. It also replaces more cooling and permeable habitat, forests and open space that mitigate heat risk and flooding.

However, poorly-designed dense urban environments can produce poor local climates. The urban heat island effect, created by heat-absorbing impervious materials like concrete and asphalt, will worsen as cities get hotter, leaving city residents with little choice but to rely on air conditioning, and increase emissions in the process. These impervious surfaces also cannot absorb storm water, causing greater risk of flooding. Twenty-first century urban design must configure densely occupied urban settlements that offset undesirable local outcomes.

Urban districts should be designed to provide cooling and ventilation that reduces the need for energy use and allows citizens to cope with higher temperatures, while enabling cities to better manage rainfall extremes. Design that integrates climate considerations, natural systems and compact urban form can result in attractive and healthy microclimates. Forward-thinking design exploits natural systems to future-proof the built environment in response to a changing climate. This includes:

- enhancing natural ventilation by harnessing prevailing summer breezes
- configuring 'win-win' green infrastructure to maximise the cooling effect of summer wind over evapo-transpiring surfaces
- strategic shading by orienting neighbourhoods according to the sun path, and
- shaping varied building forms and surface roughness to enhance summer breezes and reduce winter wind.

Investments in pedestrian and cycling corridors, particularly when integrated with parks and other green-space planning in cities, can reduce carbon emissions, enhance carbon sequestration, and cool cities through extra ventilation and shade. These approaches result in people-centred urban spaces comprising interconnected micro-climates within the city to achieve reduced energy loads, cleaner air and enhanced civic life. Woven through these climate considerations are social cohesion and well-being outcomes that are key to long-term resilience.

THE USE OF HEAT-RESISTANT CONSTRUCTION MATERIALS

Selecting low heat capacity construction materials and reflective coatings can improve building performance by managing heat exchange at the surface. From enhancing surface reflectivity with white roofs to installing high-performance building insulation, this urban climate factor provides inexpensive and quick-win options for reducing urban heat island effects. High thermal mass in buildings enhances the heat sink characteristics of the built environment and can reduce daytime temperature fluctuations. While the contemporary prevalence of lightweight building construction reduces thermal mass, a positive trend is the emergence of lightweight, high-thermal mass insulation technologies such as Phase Change Materials (PCMs}.

Alongside upgrading buildings to enhance energy efficiency, we need to cool neighbourhoods. As cities get hotter, air conditioning use increases. This produces climate change-causing emissions and, at the local level, releases waste heat into the city's microclimate. Through the use of air conditioning, many buildings are isolated from their neighbourhood microclimate. One approach would be to define a wider range of acceptable indoor temperatures, by allowing buildings to be better connected to healthier, outdoor microclimates.

VEGETATIVE COVER

Increasing vegetative cover can simultaneously lower outdoor temperatures, building cooling demand, rain and floodwater runoff, and pollution, while sequestering carbon. Small green spaces, planted courtyards, shaded areas and urban forests create a network of favourable local microclimates and moderate temperatures. The evaporative cooling process from this vegetation allows for the sustainable management of the water cycle and a reduction of the urban heat island effect. Investments in pedestrian and cycling corridors, particularly when integrated with parks and other green space planning in cities, can reduce carbon emissions, enhance carbon sequestration, and, perhaps most effectively, cool cities through evapo-transpiration and shading.

A PHASED APPROACH

These evidence-based urban form and function strategies for climate change mitigation and adaptation could be implemented in phases. The diagrams overleaf illustrate examples of short, medium and long-term phases.

Urban design that integrates climate considerations, natural systems and compact urban form can result in attractive and healthy urban microclimates

SHORT-TERM

Urban policy should favour public-private investment that prioritises climate mitigation strategies and yields concurrent climate adaptive benefits, over those that do not. Current policy and funding often sees climate mitigation (sustainable neighbourhoods) and climate adaptation (resilient neighbourhoods) as mutually exclusive. This needs to change. Districts that integrate climate mitigation and climate adaptation together, alongside urban health and well-being, are better positioned to remain liveable in the years ahead.

Assessment of the micro- and macro-climatic characteristics of a site at the start of a project needs to become standard urban design practice. The urban design community should improve standard (yet flexible) climate-responsive methods for practitioners to embed climate-responsive design in the development process. This would include the improvement of inexpensive streamlined assessment tools that would fit within the capacity of local policymakers and be comprehensible to stakeholders. This capacity-building on the part of the design and planning community could be encouraged by the adoption of urban climate-impact analysis as a legal consideration in the environmental review process. Components would include urban climate mapping and microclimate future scenario modelling of the development impact on residents and energy loads within a warming city.

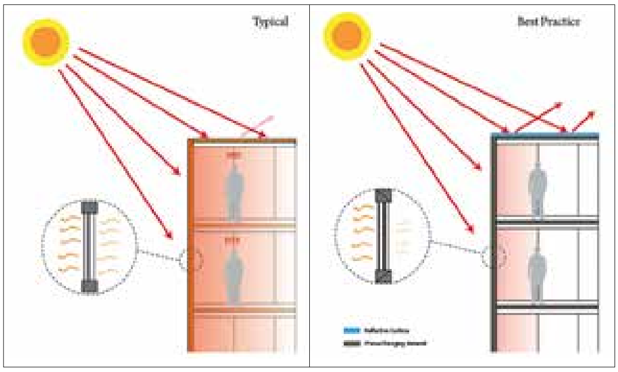
Mentioned earlier is the inexpensive, short-term strategy of enhancing surface reflectivity across urban districts and installing high-performance building insulation to help mitigate the urban heat island effect.

MEDIUM-TERM

Expanding green infrastructure corridors to protected pedestrian/cycling corridors, can reduce carbon emissions, enhance carbon sequestration and drainage. Perhaps most effectively, it can cool cities through evapo-transpiration, ventilation and shading.

LONGER-TERM

Transit-oriented development (TOD) – compact, people-centred, car-free development zones around mass transit hubs – promotes greater efficiency in reducing sprawl impact on surrounding



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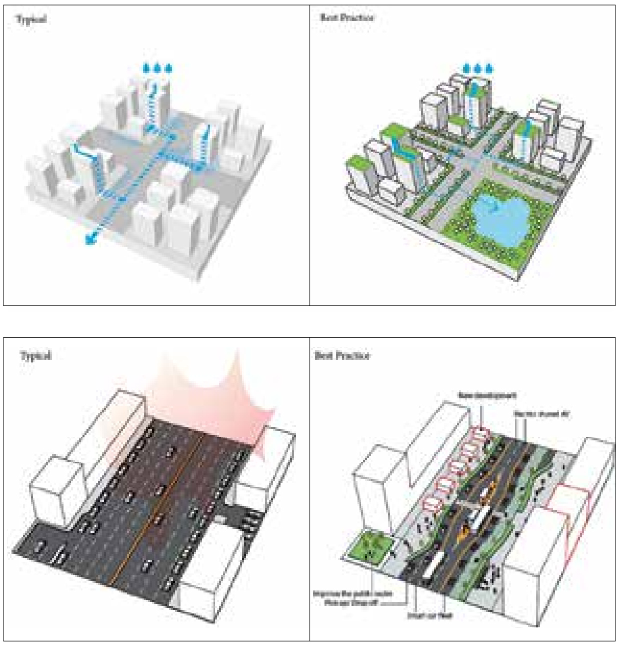

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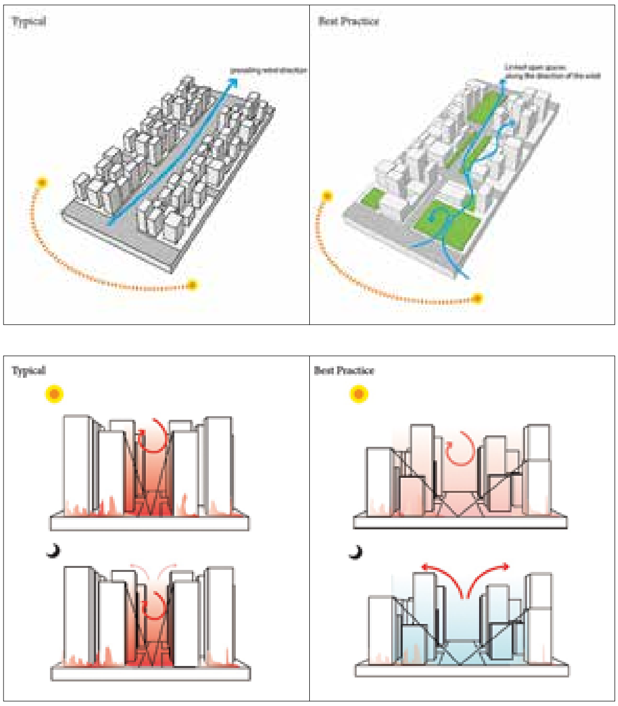

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landscapes, and should be powered by decentralised building-scale and shared district energy. A TOD's density has the potential for expanded synergies in the reuse and recycling of district energy and waste.

Retrofitting already built urban districts is a challenge. In Hong Kong for example, a series of tall, wall-like buildings block the free flow of air throughout the city. By cutting off a natural source of cool air, these buildings increase local temperatures and the demand for air-conditioning, even in the city's newest, most energy-efficient buildings. In response to situations like these, public-private carrot and stick approaches should be considered. These could include increased Sky-View Factor through the Transfer of Development Rights (TDR) on strategic sites in exchange for bonus development incentives in adjacent sites. In a dense Central Business District, 'banking' privately-owned public space (POPS) plazas should be considered. Rather than a series of random open spaces scattered without considering local climate, these banked POPS could be combined and configured holistically as linear parks to align with prevailing summer breezes and bike routes. For older industrial districts, former brownfield sites could be held and reconfigured to enhance local climate impacts.

URBAN DESIGN CLIMATE WORKSHOPS

To bridge the gap between climate science and action, policymakers, urban designers and stakeholders need tools and methods to identify, configure and evaluate urban climate factors at a local scale.

The confluence of research and operational application through Urban Design Climate Labs and Workshops (UDCW) is providing a blueprint for how to convincingly configure sustainable and climate-resilient urban districts. Led by the Urban Climate Change Research Network (UCCRN) and the Urban Design programme at the New York Institute of Technology (NYIT), these UDCWs are underway worldwide, with graduate students, urban designers, climatologists, and stakeholders working side-by-side. So far, UDCWs have been held in Paris, Naples, and several locations in New York City.

In August 2018, the New York City UDCW drew from a cross-disciplinary team of global urban climate experts from the International Association for Urban Climate, and a NYC-based team comprising UCCRN-NYIT and NYC-based urban design experts, to configure a prototype intervention to map baseline (business-as-usual) and best practice (climate-driven urban design) options. This provides compelling evidence to policymakers (and a wider audience) on the value of the evidence-based strategies outlined above in terms of financial, health and public realm co-benefits.

Subsequent urban design climate workshops are introducing participants to this process, and addressing critical knowledge gaps around 'downscaling' urban climate tools to the local scale and how to reduce uncertainties as we consider strategies and outcomes. Participants explore methodologies for identifying, monitoring, and prioritising cross-sectorial strategies to achieve best possible quality of life outcomes. The experts and designers leading these workshops provide methods and tools for all participants to better engage with each other and with forces rapidly shaping cities on a collaborative platform: policymakers, private sector, urban designers and stakeholders. ●

Jeffrey Raven, Associate Professor and Director of the Graduate Programme in Urban + Regional Design, New York Institute of Technology, New York, and Principal of RAVEN Architecture + Urban Design LLC
This article stems from Jeffrey's work as coordinating lead author of *Climate Change and Cities: Second Assessment Report of the Urban Climate Change Research Network* (2018).

2 Phasing Short-Term
3 Medium-Term
4 Longer-Term.
Source: Urban Climate Lab, NYIT 2017