URBAN HEAT DIAGNOSIS & CURES

Communities can be "hot" in different ways. Prescribing effective cooling solutions, requires getting the diagnosis right. Metro-regions, neighborhoods, and specific sites can be more or less hot because of the way they are built. Understanding what urban land features influence temperature across scales is essential for prescribing the correct Rx.

URBAN HEAT AND COOL DESIGN FACTS

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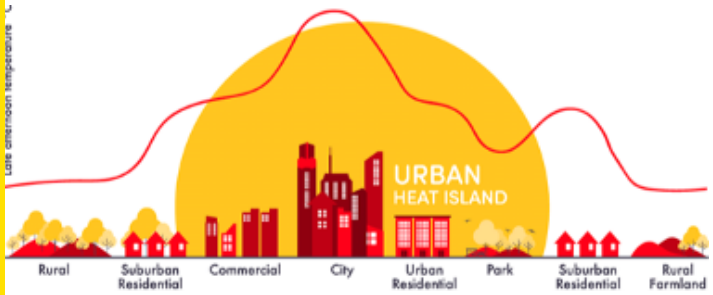
DID YOU KNOW?

Fahrenheit and Celsius are not the only terms to keep straight when talking about temperature. Both units could refer to air temperature (AT), which is what we hear about in local weather reports. Humidity can make air temperature feel hotter. Fahrenheit and Celsius could also refer to surface temperature (ST), which is what we see in thermal images, and depends on “albedo,” or how much sunlight is absorbed or reflected off materials. Low albedo surfaces like dark asphalt parking lots are hot and high albedo surfaces like cool roofs are cooler. Sometimes, we estimate land surface temperature (LST) over large areas using satellites that show how much heat radiates from materials “near” the Earth’s surface, which is technically at the top of the atmosphere. Less frequently discussed, “mean radiant temperature,” measures a variety of climate conditions, including direct sunlight exposure and the heat that surfaces around us give off and are transferred to our bodies. You’ve probably experienced changes in mean radiant temperature as you walk from the sun and into the shade. You’ll feel cooler in the shade because you are not exposed to as much sun, and the objects around you radiate less heat back to your body. Understanding the different ways, we measure and evaluate temperature is critical because each describes a different aspect of urban climate.



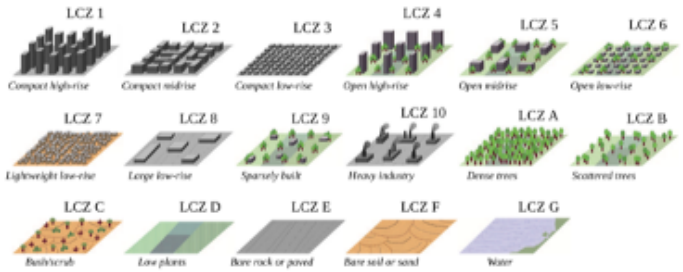


Figure 1: Local climate zone types (Stewart & Oke 2012).

URBAN HEAT ISLAND (UHI)

Metro-regions are hotter in the late afternoon and evening temperatures caused by built materials and other anthropogenic heat sources.

SURFACE MATERIALS

Increasing the amount of high albedo surfaces and vegetation will reduce excess heat from impervious surfaces.

LOCAL CLIMATE ZONES (LCZ)

Neighborhood temperature varies depending on materials, spatial arrangement, and height of different urban and natural features.

COMPREHENSIVE APPROACH

Shifting to cooler LCZs requires increasing neighborhood vegetation and reconfiguring the built features to be more conducive to shade and airflow.

HEAT STRESS

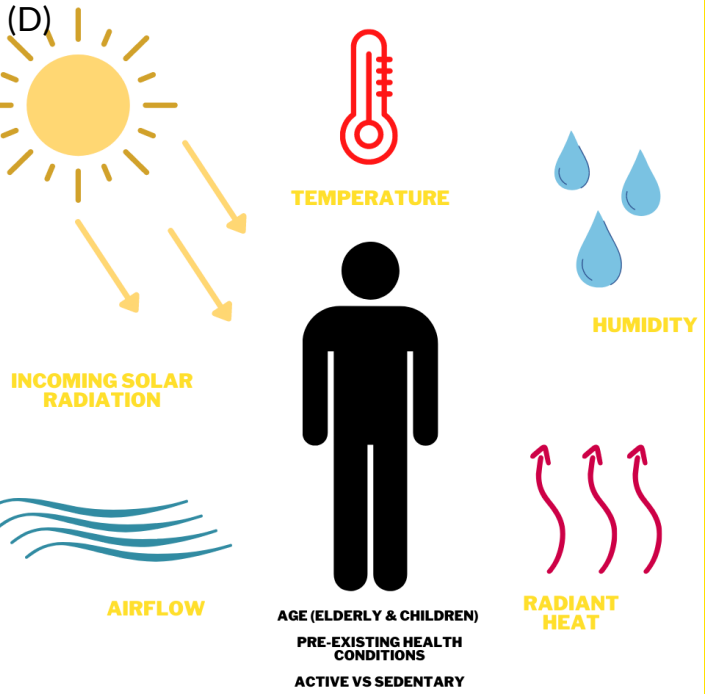
The temperature people experience when design creates conditions of full sun exposure to bodies and hot surface materials with little air circulation.

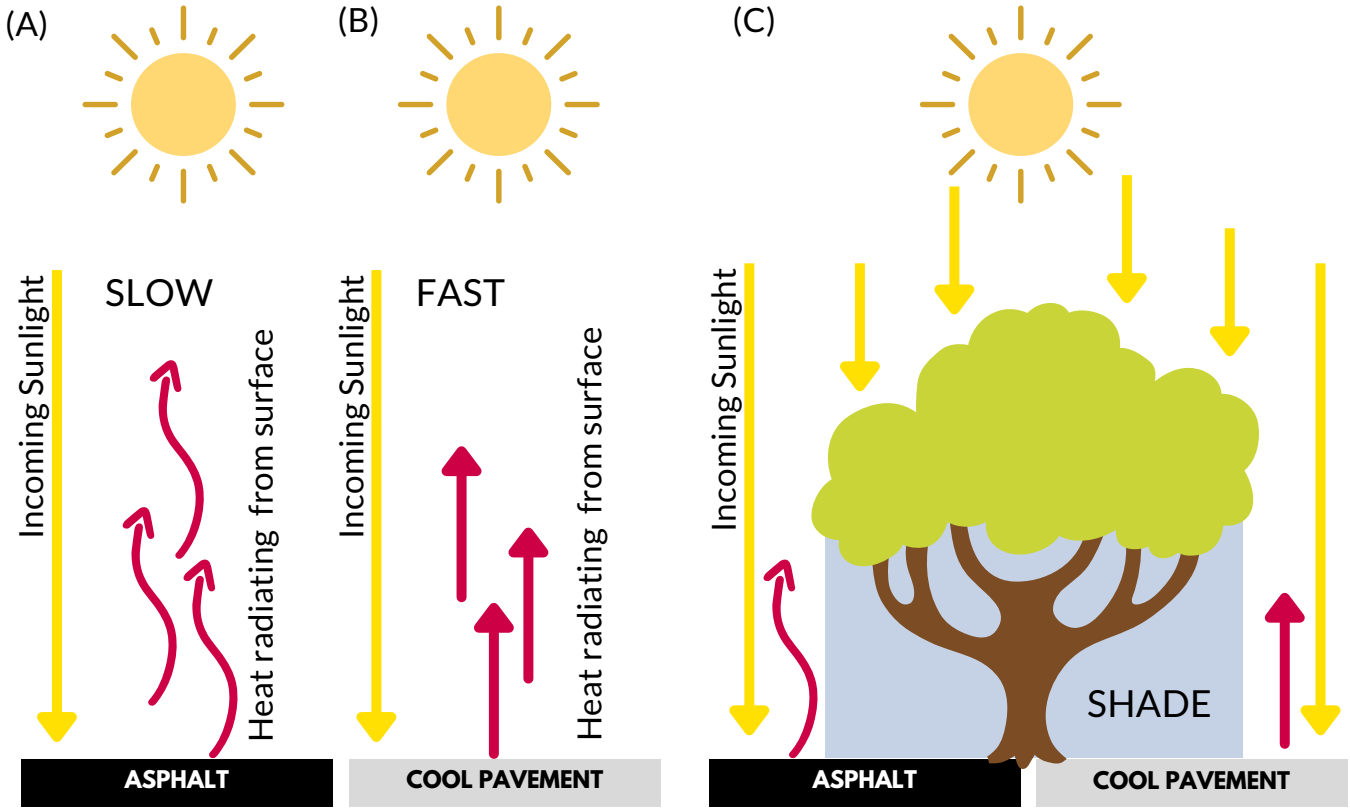
SHADE

Protecting people from direct sun exposure and radiant heat from surfaces is the most effective way to cool the human body outdoors.

MEAN RADIANT TEMPERATURE

The climate variables that make up mean radiant temperature (D) include incoming solar radiation, air temperature, humidity, airflow, and thermal properties of surface materials. This measurement helps us understand thermal comfort, or the way the human body experiences heat. It is important to note that other factors such as age and pre-existing health conditions also impact thermal comfort.





HOW DO COOL SURFACES AND SHADE WORK?

Asphalt (A) captures sunlight and slowly radiates heat back into the atmosphere, making surfaces—and people standing near those surfaces—feel hot, even after the sun has set. Cool pavement (B) absorbs less sunlight, which makes surfaces feel cooler. It works by radiating heat back into the atmosphere quickly, which means that during peak sunlight hours, people standing on "cool" surfaces feel more of that radiant heat. If cool surfaces are implemented over large enough surface areas, cooler surface temperature could also decrease air temperature. Shade (C) cools by preventing sunlight from reaching surfaces in the first place, which means that people are not exposed to direct sunlight or as much heat radiating off of surfaces. A shady spot on asphalt can be as cool as a shady spot on cool pavement.

RESOURCES

Cal OES Summer Heat Resources
https://www.caloes.ca.gov/ICESite/pages/summer-heat-resources.aspx

LA County Extreme Heat
https://ready.lacounty.gov/heat/

LA County Climate Vulnerability Assessment
https://lacounty.maps.arcgis.com/apps/webappviewer/index.html?id=c78e929d004846bb993958b49c8e8e65

OUR CHILDREN PLAY ON PARKING LOTS

Playgrounds are some of the hottest locations in communities. Children are among the most vulnerable to heat stress. Outdoor play is essential for physical and mental health, but too much heat reduces learning outcomes.

Surface temperatures are frequently hot enough to cause first-degree (118 F) and second-degree (131 F) burns. This 162 F rubber play surface (on right) in the San Fernando Valley would cause a third-degree burn!

The good news is that shade can reduce heat stress by approximately 25 to 35% throughout the day.

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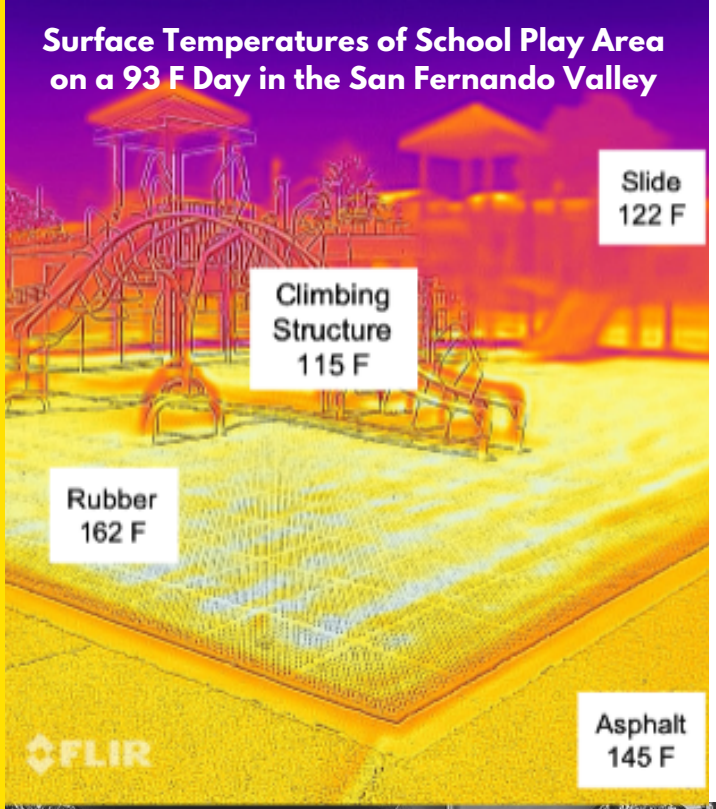

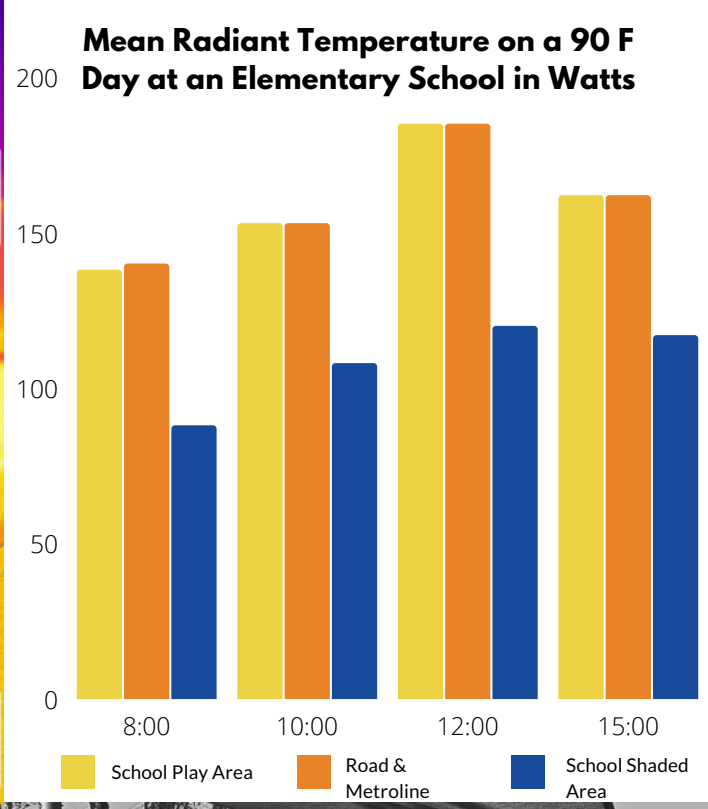

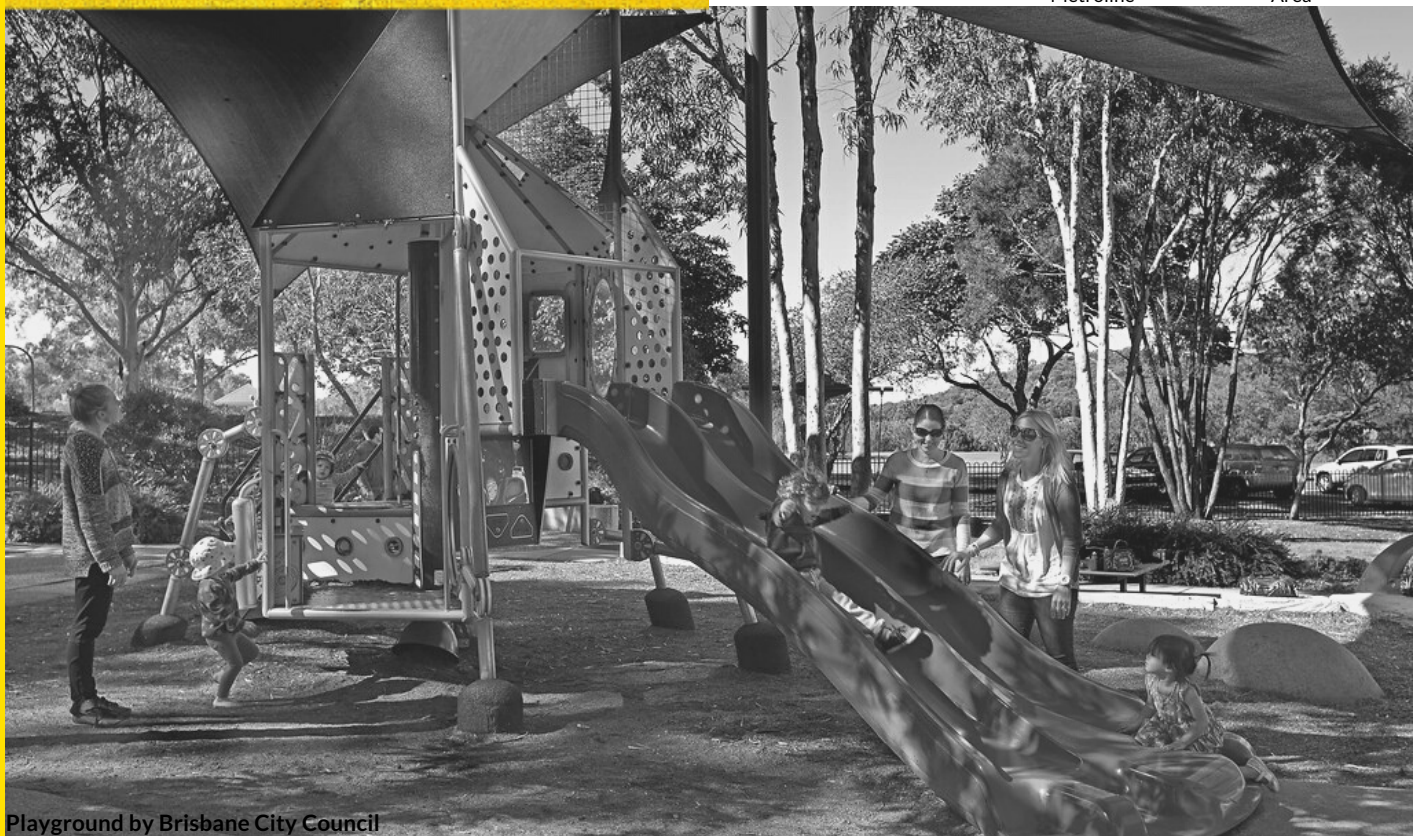

Playground by Brisbane City Council