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Subject: Urban Heat Island, Dark Surfaces, Extreme Heat Events
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At several Design Review Committee meetings, I commented on the dark colors on the exterior of buildings as absorbing more heat and contributing to heat island effect.

Living in Berkeley, we have benefited from a mild climate and the cooling fog that tempers summers and have not needed to consider heat island effect or color as anything more than a design element, however, the climate in Berkeley is changing just as it is around the world. The new York Times featured San Francisco's disappearing fog in the September 14, 2022 article. in https://www.nytimes.com/interactive/2022/09/14/climate/san-francisco-fog.html

As it turns out, the color and surfaces on buildings does have a significant impact on heat absorption including within the building, the building exterior surface and the surrounding environment from the radiating of heat from buildings and other hard surfaces. This is known as urban heat island effect. The radiation of heat from buildings and hard surfaces does not stop when the sun goes down. All the heat absorbed by buildings during the day continues after the sun goes down creating microclimates of warmer nights which in extreme heat events when people need cool nights to recover exacerbates risk of heat-related illness and death.

The first reference and quote supporting the impact of dark surfaces which absorb heat rather than reflect it is from the 2019 update of the Berkeley Local Hazard Mitigation Plan pages 180-181.
https://berkeleyca.gov/sites/default/files/2022-01/Local-Hazard-Mitigation-Plan-2019.pdf

"Urban Heat Island Effect Extreme heat events can be further exacerbated by the urban heat island (UHI) effect, through which densely-built cities like Berkeley experience higher temperatures in comparison to surrounding more rural areas. Factors contributing to the UHI effect include: A relative lack of vegetation; Reduced air flow; **An abundance of hard, dark surfaces—such as buildings,** [emphasis added] streets, cars and sidewalks— which absorb heat rather than reflect it. These surfaces also slowly release that absorbed heat throughout the night, contributing to warmer nighttime temperatures as well. The UHI effect can also worsen air quality (particularly ground-level ozone) in urban environments.The UHI effect increases heat-related illnesses and fatalities, particularly after two to three days of extreme heat. Vegetation helps mitigate the UHI effect through evaporative cooling, making urban tree cover, parks, and green roofs essential to combatting the UHI effect. Green roofs, cool roofs, and cool pavements (light-colored materials that reflect, rather than absorb, solar energy) reduce the UHI effect, and can also lower cooling loads in buildings. Urban vegetation and increased urban tree cover reduce temperatures, with co-benefits such as improving air quality and providing needed shade (for buildings and people) during heat events."

The Local Hazard Mitigation plan using the data available at the time of adoption states on page 168,

"Extreme heat events will increase in the Bay Area due to climate change in intensity, length, and frequency. By the end of the century, Bay Area residents may average six heat waves annually, which will average a length of ten days120. Extreme heat threatens critical infrastructure, air quality, and public health. The urban heat island effect, where built surfaces absorb and retain heat causing higher nighttime temperatures, can exacerbate those health risks."

As background, the Federal Mitigation Act of 2000 signed into law by President Clinton requires state and local governments to prepare the Local Hazard Mitigation Plan, a comprehensive risk reduction analysis, and to update the plan every five

years. Comprehensive Some of the FEMA relief in the event of a disaster is tied to having a Local Hazard Mitigation Plan. President Carter established FEMA in 1979.

The purpose of hazard mitigation is to implement and sustain actions that reduce vulnerability and risk from hazards, or reduce the severity of the effects of hazards on people, property, and the environment. Mitigation actions include both short-term and long-term activities which reduce the impacts of hazards, reduce exposure to hazards, or reduce effects of hazards through various means including preparedness, response, recovery, and resilience measures.

Berkeley Lab Heat Island Group has been studying how cool walls, walls on the exterior of buildings that reflect sunlight can decrease envelope surface temperature and diminish heat conduction into the occupied space. This lowers surface, radiant, and air temperatures inside an unconditioned building, and decreases cooling load (heat that must be removed from the occupied space to maintain setpoint), annual cooling energy use, and peak power demand in a conditioned building. With the possible exception of thermochromics, CEMs [Cool Envelope Materials] also tend to increase heating load (heat that must be added to the occupied space to maintain setpoint) and annual heating energy use in climates that have a heating season.10 Direct benefits and penalties. The "direct" cooling benefits and heating penalties of CEMs—meaning those attained by reducing the building's net radiative heat gain—have been assessed in over 30 countries and regions. https://heatisland.lbl.gov/coolscience/cool-walls
Berkeley Lab projects on cool walls https://heatisland.lbl.gov/projects/cool-walls

Berkeley Lab Heat Island Group Web page lists Urban Heat Island resources https://heatisland.lbl.gov/resources/Guides and there are many other sources that can be accessed through an internet search.

American Chemical Society on cool walls and impact on heat island effect
https://pubs.acs.org/doi/10.1021/acs.est.8b00732

Scientific research demonstrates color, reflective qualities on exterior wall surfaces on buildings does matter. Where as cool roofs are more widely accepted, cool walls on multi-story buildings with greater surface area than roofs carry greater impact on heat island effect.

Within this frame of responsibility and action, please reconsider exterior color and surfaces of buildings in relation to reflecting rather than absorbing heat in response to a future of a warming climate with unpredictable potentially catastrophic climate extreme heat and weather events.

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