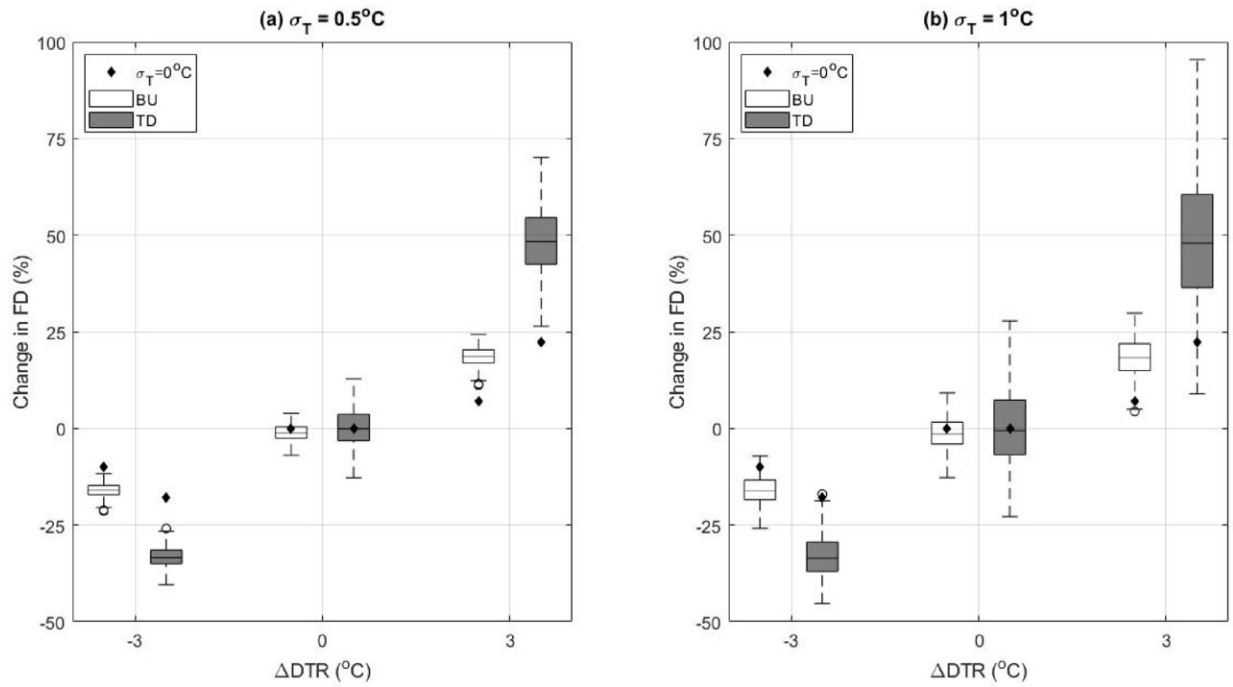
Climate change creates complications for concrete

November 14 2022



Distribution of change in fatigue damage as compared to the existing climate for different climate change scenarios assuming a standard deviation of (a) 0.5°C and (b) 1°C for the 250 mm thick pavement in Phoenix, AZ. Credit: *Results in Engineering* (2022). DOI: 10.1016/j.rineng.2022.100736

Pennsylvania drivers know the effects that weather can have on paved roads—potholes, cracks and other pavement woes are a common occurrence. Climate change is accelerating the process, with devastating

consequences for infrastructure.

Concrete is thought to be better able to withstand intense heat than asphalt, which softens in the heat. However, new research led by Lev Khazanovich, Anthony Gill Chair Professor of civil and environmental engineering at the University of Pittsburgh Swanson School of Engineering, finds that's not quite true.

The paper, published in the journal *Results in Engineering*, found that while concrete pavements are unaffected by an average increase in air temperature, they are extremely sensitive to sharp variations in air temperature during the day.

In other words, as days get hotter and nights get colder, concrete pavements will be badly affected.

"Concrete roads constitute less than 5% of all roads in the United States, but they carry about 26% of all vehicle-miles traveled and punch well above their weight when it comes to moving the economy forward," explained Khazanovich.

"Concrete does not change its properties regardless of how hot it gets. There was an untested belief that this meant concrete pavements are resilient to extreme temperatures, but now we know that's not the whole picture."

The study looked at the effects of such increasing extreme heat events in both mild and hot climates and found that concrete pavements in mild climates would be affected even more. Furthermore, they found that thicker pavements are more sensitive to extreme temperatures than thinner ones—meaning that major highways and freeways are at the greatest risk.

Khazanovich worked with postdoc Sushobhan Sen and graduate student Haoran Li on this research. They explained their findings based on the mechanics of how concrete pavements develop thermal stresses, which differs significantly from asphalt pavements.

"As the climate continues to warm and temperature shifts become more extreme, we will need to develop innovative technologies to address the accelerating degradation of our roadways. For example, innovative concrete pavement cooling technologies, like cool and reflective pavements, could make them more resilient to extreme heat," said Khazanovich. "It's vital to our nation's economy that our infrastructure evolves to handle the realities of a warming planet."

The paper was published in *Results in Engineering*.

More information: Sushobhan Sen et al, Effect of climate change and urban heat islands on the deterioration of concrete roads, *Results in Engineering* (2022). DOI: 10.1016/j.rineng.2022.100736

Provided by University of Pittsburgh