

Maintaining bridges on a budget

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What if there was a way to vastly improve the safety, durability and sustainability of bridges across North America without increasing spending? This was the question Saleh Abu Dabous set out to answer when he began his PhD at Concordia. "I was looking for an applied way to do research — something that would have an impact on society and improve the current situation," he remembers.

In a paper published in the *Canadian Journal of Civil Engineering*, Abu Dabous and his thesis supervisor Sabah Alkass, professor of in the Department of Building, Civil and Environmental Engineering, came up with a new decision-making approach that could revolutionize how cities manage [bridge](#) infrastructure.

"Most bridges in North America are in really bad shape," says Alkass. "We talked to different municipalities, and the reason is that they just don't have funds. The budget is so limited that they normally do corrective maintenance. But in the long run, although it requires more planning, it's actually cheaper and more effective to avoid problems now rather than fix them later."

The new decision-making method developed by Abu Dabous and Alkass prioritizes preventive maintenance. Rather than try to repair an entire network of bridges and overpasses all at once — which in large cities could mean up to five thousand structures — the method helps decision makers choose which bridges to focus on by assessing several factors. Bridges that get a lot of traffic, have an inefficient drainage system, are at seismic risk and are in poor condition would be at the top of the list.

The method takes into account the fact that some criteria are more important than others: a bridge that is in poor condition would be prioritized over one that has an inefficient drainage system.

After assessing which bridges require the most attention, the next issue facing decision makers is whether to rebuild the bridge, repair it or increase maintenance.

With three different rehabilitation options — each with its own price tag — and an entire network of bridges, figuring out which bridges to rebuild and which to repair while staying within the budget is a challenge. The paper calculates that there are over three billion rehabilitation possibilities when considering just 20 bridges.

Abu Dabous and Alkass had experts choose the best option — rebuilding, repairing, or maintenance — for each bridge in their sample and then entered the information into a computer program that simulated all the different possibilities and calculated the cost of each. "This simulation process has never before been applied to making decisions on maintenance strategies for bridges," says Abu Dabous. It is a powerful tool that can incorporate both expert opinion and a systematic assessment of bridges to identify the best strategy within a limited budget.

The method can also take into account other factors in the decision making process that previously weren't given as much weight. "We need to think about the [sustainability](#) of our infrastructure for future generations," says Abu Dabous. "Beyond the cost are factors such as safety, environmental impact and the impact on the users of the bridge."

The new decision-making method has already caught the eye of the Canadian Society of Civil Engineering, which selected the article for the honorable mention in the Stephen G. Revay Award competition for best

paper in construction engineering and management. Abu Dabous and Alkass hope that the award will encourage Transport Canada to provide more data, which could then be used to build a publicly available web-based version of the program, giving cities access to this new decision making method.

Provided by Concordia University

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