In Toronto, chunks of concrete seemed to be falling off the 60-year-old Gardiner Expressway every week this summer.

In Montreal, many of the concrete structures that went up in the heady days before Expo '67 are crumbling, including the Turcot Interchange and the aging Mercier and Champlain Bridges.

And just this week, it was announced that an inquiry into the deadly mall collapse in the northern Ontario community of Elliot Lake last June is likely to begin in early 2013.

All over this country, structures that opened with great pomp and fanfare decades ago are becoming headaches and eyesores as they age and fall apart, potentially endangering the lives of the residents who've come to rely on them.

How much longer can these concrete structures last? And why do we keep using concrete when we know it's just a matter of time before it crumbles?

Those are the questions that structural engineers are asked every day. But it seems there are few clear answers.

Samir Chidiac, an expert on structural materials and a professor of civil engineering at McMaster University in Hamilton, Ont., says it's often a near-impossible task to try to determine the lifespan of a concrete structure, because there are simply so many factors to consider.

"In Canada, we know there are two main things that damage concrete structures: we have freeze-thaw, and we have road salt, which leads to corrosion. These are the two main elements that lead to deterioration," he says.

As every Canadian who has ever driven over a pothole knows, water has a way of seeping into roadways and concrete. And when it does, it expands as it freezes, then shrinks again when it thaws, causing cracks.

Water mixed with road salt can rust a bridge's rebars -- the reinforcing bars that strengthen the concrete – which then warp, causing more cracks.

If not tended to in time, that salt and water will eventually make its way to the steel beams that hold the structure up, risking the kind of horrific collapse seen in Laval, Que., when a 2006 overpass collapse killed five.

It doesn't help that summer's high temperatures take their own toll on concrete. And increased vehicle traffic puts further weight on bridges, accelerating their demise.

It's up to structural engineers to decide when a bridge or overpass has reached the end of its lifespan. And to do so, they turn to a number of technologies to evaluate how a structure's concrete is resisting all the forces against it.

Engineers can do core testing to extract a large cylinder sample of concrete and evaluate its residual strength, or to see whether salt is causing it to break up.

But because such tests destroy a small section of the structure, engineers prefer to do tests from the outside, using methods with such names as ground-penetrating radar, thermography, and pulse velocity tests. There's also impact-echo testing, which sometimes involves dragging chains across a structure to listen for hollow sounds and spot internal crumbling.

Recently, an Ottawa start-up called Giatec Scientific Inc., developed a hand-held device that it says can detect areas of concrete deterioration using electrical resistance tests.

The system assesses diffusion and can help calculate how long it will take moisture to seep through the concrete. Unlike current lab tests, which can take weeks, Giatec's system gives a reading in just five seconds.

"The technique isn't actually new. What's clever is the portable system they developed," says Chidiac.

But even the finest test isn't foolproof, says Chidiac.

All these tests can evaluate only local spots; they can't assess the integrity of the structure as a whole. Nor are they predictive: no one test can tell inspectors how much longer a structure can stand.

"So what we end up doing is using as many of these tests as possible to try to understand what's happening inside the structure," says Chidiac. "We look at all the results in relation to each other.

"Sometimes they give us good information, sometimes they don't. That's why it's difficult for engineers to assess the structure in a conclusive way."

So if it's so difficult to predict the lifespan of concrete, why do we keep using the stuff? The simple answer: it's cheap and it works.

"Cement and concrete are not going anywhere. They are still the most economical material," says Chidiac. "And they can be formed into any shape. Concrete can also be made on site. That's why it's the number one construction material worldwide."

Engineers have experimented with other materials and polymers. A number of bridges have gone up in recent years made of FRB, or fibre-reinforced plastic, for example. But such materials are very expensive, says Chidiac, and come with their own problems.

So for now, concrete is the best we've got.

The good news is that the technology is improving, thanks to the use of finer particles and the addition of supplementary materials that can strengthen it.

"We have much better concrete today than before," says Chidiac.
But nothing, he says, will stop the forces of nature from working to destroy concrete.

"There's no such thing as foolproof material; they are all engineered materials and that means they want to resort back to their original state," says Chidiac. "The best approach is simply to assume that something is going to go wrong and mitigate that."

Source:
http://www.ctvnews.ca/canada/with-bridges-crumbling-why-do-we-still-use-concrete-1.1012364#ixzz2B4hymxGN