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Maintenance & Repairs

Understanding Underground Parking Garages

How to Build an Informed Parking Garage Strategy That Will Serve Your Corporation for Years to Come

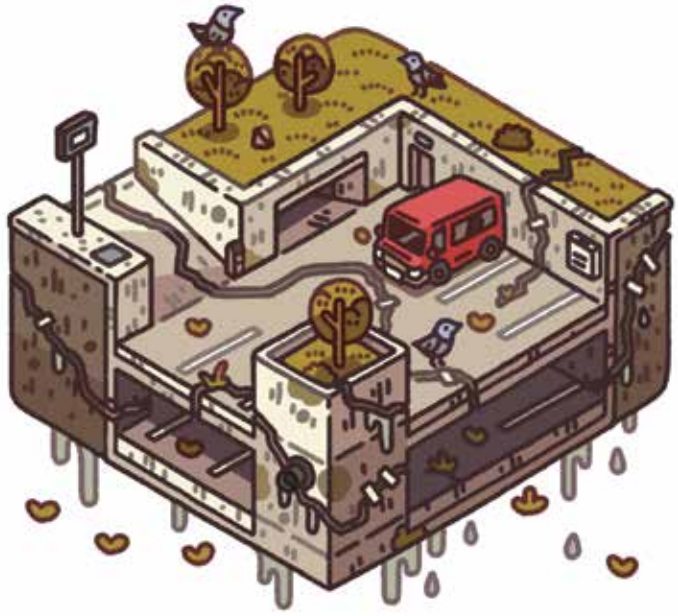

ILLUSTRATION BY HAYDEN MEYNARD

Parking garages are not sexy. Nobody is walking up to your condo and saying "The building looks tired and run-down – but just look at that gorgeous underground parking garage! I can't wait to move in!"

Listen, we get it. All too often we find Corporations looking to defer major parking garage repairs in favour of, say, a lobby renovation. But your parking garage is not a building component to simply put off until repairs are absolutely necessary. Understanding your underground parking garage and its components, and planning for condition assessments, testing, and periodic repairs are all key steps to a successful garage asset management strategy. Let's get to know your garage, what to look for and test for, and how you can build an informed strategy that will serve your Corporation for years to come.

More Than Just a Place to Park Your Car

To identify the sources of potential concealed deterioration in a parking garage, it is important to understand the different components that make up a garage. Typical underground, multi-level parking structures will often contain the following key structural and water management components that require repair:

Slab-on-grade: A concrete slab that serves as the lowest level of the structure that set directly on the ground (i.e. there is no occupied space below). These slabs are typically reinforced with welded wire mesh (not rebar) and do not have any waterproofing.

Suspended slab: A concrete slab with embedded reinforcing steel bars above the ground level that has occupied/accessible space below. These slabs are typically covered with a waterproofing membrane (e.g. mastic, elastomeric, etc.) to protect the concrete, reinforcing steel, and the space below from water and contaminant infiltration.

Mastic Waterproofing: A hot-applied, water-based, modified asphalt water-resistive barrier; typically 20-30mm in thickness.

Elastomeric Waterproofing: A thin, cold-applied, water-resistive system applied to the exposed concrete slab surface. Fine aggregate is often embedded in the membrane to add slip resistance.

Roof Deck: Sometimes called a Roof Slab, this is the top suspended slab, typically exposed to the elements and protected with a waterproofing membrane as well as various overburden finishes like asphalt paving, landscaping, concrete curbs, and walkways.

Columns & Beams: Additional reinforced concrete structural elements necessary to for load transfer from you and your car to the foundations and footings below.

Drains: Drains should be strategically placed at low points to remove any potential for ponding water and withstand the volume of water the garage slabs may experience.

Expansion Joints: Flexible, water-tight joints installed to accommodate thermal

movement of the parking garage while remaining water-tight. Expansion joints are a common source of leaks.

Out of Sight, But Hopefully Not Out of Mind

Parking garage deterioration can often be visually identified, but understanding concealed deterioration mechanisms will require testing. Fortunately, there are testing methods that have been developed to examine and quantify deterioration, which in turn helps with budget planning. Listed below are some types of concealed deterioration as well as proven testing methods used to gain a better understanding of corresponding component conditions. Note that we have covered some generic methods below, but site-specific circumstances and/or construction types will vary:

Parking garage deterioration

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Delaminated Concrete: When embedded reinforcing steel bars corrode, they expand and cause the surrounding concrete to crack and separate. This is more commonly referred to as concrete delamination. As delamination progresses, small sections of concrete may become loose and fall, often referred to as spalled concrete.

How to: *Chain Drag and/or Hammer Tap Survey:*
This non-invasive process involves dragging a heavy chain or tapping a hammer against exposed concrete surfaces and listening for a deep hollow sound. A deep hollow sound indicates that the concrete has delaminated, very often indicating that reinforcing steel is corroded. When slabs are protected by thick waterproofing systems like mastic or by overburden, investigative openings are often required.

De-Bonded Waterproofing: When waterproofing is installed on the topside of a concrete slab, surface preparation of the slab is critical to allow for proper adhesion. When the surface is improperly prepared and/or over time, the waterproofing membrane will become de-bonded from the slab below and becomes more susceptible to water and contaminant infiltration.

How to: *Test Pits for Roof Deck Waterproofing:*
This invasive procedure involves excavating a sample area (say 1m2) of roof deck overburden to expose the waterproofing membrane adhered to the roof deck. A section of the waterproofing membrane is cut and tested for adhesion, flexibility, and thickness to determine its condition. Repair the test cut!

How to: *Chain Drag Survey for Mastic Waterproofing:*
Much like the chain dragging process in identifying delaminated concrete, this process also involves dragging a chain across mastic waterproofing; when a deep hollow sound is identified, this is a likely indication that the waterproofing has de-bonded from the concrete substrate below.

Note: *the hollow sound may instead/also indicate a location of de-bonded concrete below. Investigative openings are often required to confirm.*

Chloride Contaminated Concrete: When chloride contaminated water, often from de-icing salts, is able to bypass a garage slab waterproofing membrane, the water migrates through the reinforced concrete slab and causes the embedded reinforcing steel to corrode. Maintaining waterproofing systems is a crucial step to protecting your garage from deterioration.

How to: *Chloride Testing:*
This invasive procedure involves taking core samples (i.e. cylindrical partial- or full-depth sections) of a concrete slab and sending those samples to a laboratory to be

tested for chloride contamination. Chloride levels above a certain threshold are deemed "chloride contaminated", and mean the reinforcing is susceptible to corrosion.

Carbonation Contamination in Concrete: Over time, as the undersides (or soffits) of concrete slabs are exposed to atmospheric carbon dioxide which reacts with moisture in the concrete and the concrete itself to form calcium carbonate. This causes the pH of the concrete to drop and, once this contamination reaches the level of the bottom layer of reinforcing steel, the steel then becomes susceptible to corrosion.

***How to:** Carbonation Testing:*
This testing method involves drilling small holes from the underside of a slab incrementally (~1/4" at a time) deeper and using a PH indicator to determine the depth of contamination. The indicator turns purple when added to a powder sample extracted from the hole that extends beyond the contaminated layer of concrete. This establishes the contamination depth and can be compared to the depth of reinforcing steel to assess risk. Carbonation depth can also be checks on a core sample if it is full depth.

But What's Best for My Corporation?
When managing a major physical asset like a parking garage, it is important to be able to set budgets to plan for localized repairs that can extend the service life of the garage. Deferring major repairs is your goal, but not by neglecting your garage and letting it fall apart.

For example, it is crucial to identify deteriorated waterproofing locations evidenced by leaking cracks. Repairing the waterproofing right away is low-cost and highly effective at protecting the concrete slab. Allowing the leak to continue will eventually lead to corroded reinforcing steel, delaminated concrete, and much more costly repair invoices.

Completing periodic targeted Condition Assessments will identify these major risk items, provide the Board with options for how to proceed, and ultimately will provide budgets and timing that can be incorporated into your Reserve Fund Study. If your garage is over 20 years old, you should plan for a Condition Assessment every ~5 years.

Looking Down the Drive Lane (Road)
It is important to note that completing a Condition Assessment does not change the condition of your garage. It does, however, provide valuable information that can inform and guide your repair strategy at both the project level and the RFS level. In carrying out repairs, always check to see how it fits into the bigger picture. Should we do a localized repair this year, or is it better to wait two years until a larger major repair project can be carried out? Should we replace our waterproofing every 10 years, or can we simply complete a repair intervention that will extend the service life? All these costs need to be planned for and cycled in your reserve fund study to create repair allowances, minor repair projects, and major repair / replacement projects.

See how it fits
into the bigger picture. Should we do a localized repair this year, or is it better to wait two years until a larger major repair project can be carried out?

Understanding your underground parking garage, its component parts, and completing periodic Condition Assessments to guide maintenance, testing, and periodic repairs are key to providing your residents with a safe place to park and the Board with peace of mind. Incorporate the Condition Assessment findings into your Reserve Fund Study as part of an informed long-term strategy. Hey, maybe you can afford that lobby renovation next year after all! CV