Reinforced Concrete Inspection: How to Prevent Corrosion

Almost 6-months after the devastating collapse of Miami's Surfside condo building, the grand jury of Miami-Dade County released a 43-page report calling for major reforms to prevent similar tragedies. Among the various recommendations, the report stated, “If we do not build safely, if we do not immediately institute suggested improvements to the policies and procedures ... we predict that the Chaplain Tower South Condominium building will not be the last partial building collapse in our community.”

The 150ft tall condo building, built with reinforced concrete slabs, had endured hurricanes and the challenging Florida weather for 40 years before its devastating collapse. Now, reinforced concrete structures are under stricter scrutiny to prevent the same happening to other buildings of the same age.

In the past, reinforced concrete structures were thought to last over 100 years or more, but realistically the lifespan can be less than 50 years before urgent repairs are required. Reinforced concrete structures in salty coastal environments are at an increased risk of corrosion.

Many other structures such as reinforced concrete bridges, tunnels and buildings around the world are aging and in need of repair. Despite reinforced concrete being a safe and strong material, there are several ways it can corrode over time and this ultimately leads to 'concrete cancer'.

Types of reinforced concrete inspection

This complex challenge can be simplified into a four-step process:

1. **Periodic visual inspections & condition assessments** – This includes documenting and correction of any birth-defects on new structures and follow up with health checks during service life for actionable maintenance

2. **Deep data inspections** – Preventive inspections using a combination of visual assessments, checking of vital signs with non-destructive testing and imaging to detect sub-surface defects. Checking strength & uniformity, homogeneity & thickness, defects, rebar cover & diameter, and permeability.

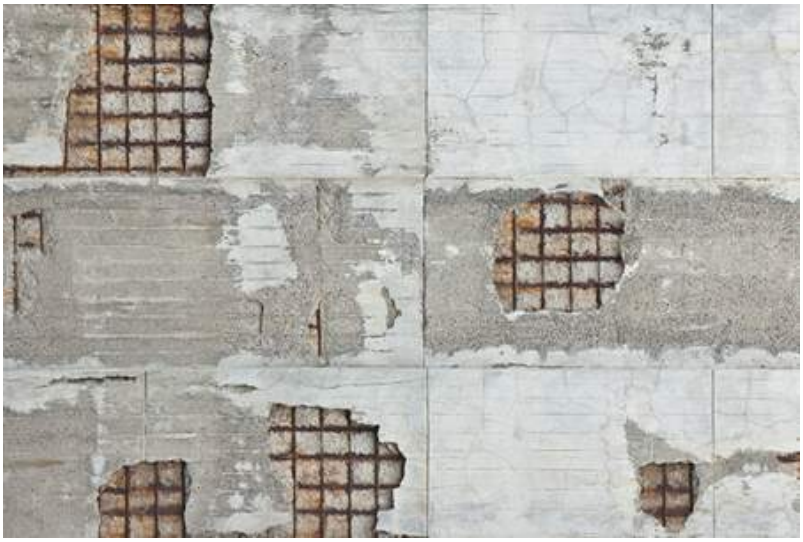
3. **Preventive repairs** – Solve issues before they become big and unmanageable problems like the case with the Champlain Tower building in Miami.

4. **Predictive maintenance** – When lives are at risk, safety should not be left to guess work. Predictive maintenance puts safety, efficiency and asset value first.

But really it depends only on taking action. Let´s look at each step in more detail…

Periodic visual inspections and condition assessments

Rebar corrosion and concrete cancer have many causes. Preventing it, requires good designs and high-quality construction, combined with quality assurance and quality control during AND after the construction.



Concrete cover, homogeneity and concrete strength are the key parameters to determine if your structure is at risk of developing concrete cancer (corrosion, cracking, spalling, failure…).

With intelligent inspection software, it is possible to determine if these parameters are in the green = no actions required, in the yellow = preventive maintenance to be planned before concrete cancer develops, or in the red = concrete cancer is already happening…

A visual inspection workflow, combined with smart sensors and software allows you to know when to act before anything breaks or collapses!

Deep data inspections

There's no doubt about it, preventive inspection drives predictive maintenance. But there is no one silver bullet tech that does it all.

Like for us humans, only a combination of checking vital signs, imaging (X-ray, MRI, CT etc.) and blood tests can give the full picture. It's the same for assessing the health and strength of reinforced concrete structures. A multi technology approach is the only way to inspect our aging global assets accurately and efficiently.

By using multi-technology preventive inspections, you get the Deep data to drive pro-active maintenance to prevent rebar corrosion.... and many other problems. The vital signs of the building or structure is checked with non-destructive testing, evaluation and thorough inspections.

We could go into great detail of how to inspect and protect concrete structures (In fact, we have in this free 330-page eBook), but for the sake of this article, let's summarize it into the key parameters for assessing whether the structure is at risk of developing concrete cancer, and which technologies can be used for preventive inspections. You can also use this as a reinforced concrete inspection checklist:

- **Concrete strength & uniformity** – The most widely used methods of testing concrete strength and uniformity are with Rebound technology and Ultrasonics Pulse Velocity and Ultrasound Pulse Echo.
- **Homogeneity & thickness** – Ultrasonics Pulse Velocity is perfect for homogeneity and strength estimation, and Ultrasound Pulse Echo for slab thickness measurements.
- **Defects** – For detecting defects such as delaminations, voids, or honeycombing, Ultrasound Pulse Echo works well for reinforced concrete.
- **Rebar cover & diameter** (spot-check) – The Pulse Eddy Current principle is the only imaging technology which is not influenced by concrete composition and humidity, leading to high cover accuracy in every scenario. This makes it highly suitable for applications such as reinforced concrete bridge inspections.
- **Resistivity** – The resistivity of concrete is a valuable health indicator and can be accurately defined based on electrical resistivity measurements on the concrete surface.
- **Rebars, tendons, cables, pipes** (objects) – Whether you need to locate objects inside concrete within small spaces, or large areas need to be scanned, Stepped Frequency Continuous Wave Ground Penetrating Radar technology provides

both depth and high resolution imaging. It can also be used in tight areas making it ideal for applications including reinforced concrete pipe inspection.
- **Corrosion potential** – To access and map the active corrosion in the structure, advanced Half-Cell technology works with a corrosion sensor for an efficient solution.

Preventive repairs

With Deep data, repair decisions can be made faster and more accurately - this is key for structural health and prioritizing the necessary preventive repairs.

Using the green, yellow or red priority classification on INSPECT intelligent inspection software, preventive repairs can be managed more efficiently before they become bigger problems. And with prioritization no longer left to guesswork, preventive repairs can be made on the most critical issues first, so it doesn´t pile up and become unmanageable.

Furthermore, contractors, owners, future inspectors and buyers will have up to date information on the building when needed. Since everything can be stored securely in one Workspace, all measurement details can remain accessible for years to come.

This means that when the structure is due for repairs at any time in the future, it will be clear what needs to be done and exactly where. Everything is geolocated and the findings can be viewed on a 2D drawing, or on a 3D digital twin of the structure.

Why is this so important?

As the residents of 432 Park luxury condominium in New York found out, when the repair workers get the location of the object even slightly wrong, the result can be disastrous. In this case, a contractor mistakenly drilled into electrical wiring when doing a repair, causing an explosion that ended up costing more than $1.5 million.

That´s why the previously mentioned technologies are designed to be used to prevent these mistakes, ultimately increasing the health of all types of concrete structures and keeping the users safe.

Predictive maintenance

Artificial intelligence has transformed many industries and inspection technology is no different. Using AI and machine learning in inspection software, it becomes possible to not only see the current situation clearly, but also predict the future maintenance requirements with solid data driven models.

Powered by the Deep data from intelligent and autonomous inspections, predictive healthcare for structures extends the asset´s life and increases long-term value for asset owners.

Knowing the what the condition of the asset will be like in decades to come doesn't have to be speculation, estimation or optimism. It can be based on factual data for accurate predictive maintenance.

Conclusion

Now it really depends on acting as a collective to prevent deterioration of reinforced concrete structures. The team at Screening Eagle are by your side with expertise and the complete solutions to beat rebar corrosion before it even occurs. That is correct... BEFORE it even occurs.

Say no to concrete cancer and yes to structural health. Be smart and perform preventive inspections driven by technology and not by paper and pencil guesswork.

Don't forget to download our FREE in-depth guide on How to Inspect and Protect Concrete Structures.

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