

NARPS

Non-destructive Assessment
of the Resistivity, Chloride and
Carbonation Profiles in concrete



where business meets innovation

New Technology from DIT



Hand-held, non-destructive, rapid chloride assessment in concrete structures

Reinforced concrete, containing embedded steel reinforcement, is widely used in all forms of civil infrastructure. Over time, the steel bars can begin to corrode. Researchers in Dublin Institute of Technology's Civil Engineering Research Group (CERG) have developed an innovative hand-held,

non-destructive instrument (NARPS) for the detection of chlorides and carbonation in reinforced concrete.

Current corrosion testing of reinforced structures relies upon either chloride or carbonation chemical testing, both of which are traditionally lab-based tests. This form of testing relies upon the extraction of concrete dust samples from the structure, which can affect structural integrity and requires significant planning (scaffolding and extensive traffic management), significantly adding to test cost and duration. NARPS allows maintenance and inspection companies to quickly assess the

level of corrosion without the need for drilling or laboratory analysis, significantly reducing turnaround times and level of traffic disruption, while maintaining structural integrity.

The system consists of a sensor head and a handheld recording and display unit. The sensor head is placed in direct contact with the surface of the concrete structure under test, with the electrical resistivity measured through the depth of the concrete. This electrical resistivity is correlated with the level of chlorides in the concrete and displayed in a user friendly manner on the display unit.

Applications

This technology can apply to any structure which uses reinforced concrete, with a particular emphasis on:

- **Bridges** – NARPS could find applications in the construction of concrete structures including in-situ and precast bridges, as well as the in-situ maintenance and inspection sector.
- **Pre-Cast structures** – applications include buildings, landscaping, storage tanks, culverts, 3-sided structures, highway and traffic-barriers, retaining walls, etc.
- **Piers** – applications include water interacting structures due to their placement in harsh marine environments which are often completely submerged or saturated with water.

Opportunity

The primary opportunity lies with the inspection and maintenance of bridges as they tend to be owned by only a few organisations at national level. The cost to the exchequer of maintaining existing concrete building stock is substantial with many owners not in a position to provide much needed funds.

There are approximately 1,500 concrete bridges in Ireland, approximately 30% of which are at most danger of damage due to close proximity to the sea. In the US, of the estimated 900,000 concrete bridges in use, approximately half are seriously damaged and one fifth are structurally deficient or functionally obsolete due to corrosion.

The American Society for Civil Engineers (ASCE) report in 2009 stated that \$17 billion was needed for annual bridge maintenance.

Any solution developed for bridges can be quickly expanded for other concrete structures such as tunnels, piers, buildings, landscaping, utility and transportation.

Advantages

This technology offers a number of advantages:

1. **Fast & Reliable Field Testing** – NARPS does not require concrete dust extractions or laboratory testing, and minimises turnaround and site access time and costs.
2. **Ease of Use** – NARPS operates by being placed in direct contact with the structure under test, thus removing the need for drilling and dust removal, while maintaining structural integrity and removing the need for laboratory analysis.
3. **Minimised disruption** – because the NARPS sensor-head only needs to be in contact with the surface under test for a short time, it causes minimal disruption. This is extremely important when testing in difficult, hard to reach locations where high traffic volumes are present.
4. **Flexibility** – the core technology can be used on a wide range of concrete structures.

“Fast, reliable field testing of the corrosion levels of reinforced concrete structures with fast turnaround, low testing cost and minimal level of disruption.”

Stage of Development

This technology was developed by the Civil Engineering Research Group (CERG) based in Dublin Institute of Technology (DIT) Bolton St. The CERG is involved in a wide range of construction material and structural engineering research. The CERG are also heavily involved in industry collaborations including strength, vibration, durability, life-cycle, tensile, and compression load testing for concrete, timber and steel bolts.

NARPS is at laboratory prototype stage with initial results showing strong correlation between measurements obtained and level of corrosion. State funding has been received to build out a commercial-ready prototype.

DIT is currently seeking expressions of interest from companies interested in licensing and developing products based on this technology.

An initial patent application for “Detection System and Method in Concrete Structures” was filed in 2014 – GB1406000.8.



Above: CAD drawing of the intended NARPS product.

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