Taking a good look at concrete structures

Reinforced concrete is considered to be a versatile and extremely robust building material – but it's not indestructible. Over time, moisture and de-icing salt corrode the reinforcement. The problem is that inspections are expensive, and the results of wear and tear – even those due to design flaws – are not always visible on the outside. Researchers at Fraunhofer IZFP have now developed a new system with which concrete structures can be inspected comprehensively for damage.

Structures such as multi-story and underground parking garages or bridges must be able to withstand a lot. Vehicles bring moisture and de-icing salt into the structure, the open design leads to changing climatic conditions, cars wear down the driving surface, and their exhaust fumes cause pollution. Over time, this leads to corrosion damage and the stability of the structure suffers.

To guarantee the safety of buildings, their condition must be checked at regular intervals. But conventional investigations are time-intensive and therefore expensive. The current state of the art means that they can only be carried out point wise and involving intricate sample-taking. Invisible damage thus remains undiscovered. The costs of the inspections are enormous: in a multi-story parking garage, for example, experts calculate the costs at around 50 € per parking space.

Several measuring methods in a single system

A new type of technology could make these inspections more effective and comprehensive in the future. Together with several partners, researchers at the Fraunhofer Institute for Nondestructive Testing IZFP have developed an automated system that can be used to inspect concrete structures. The BetoScan system is a self-navigation robot platform with non-destructive testing sensors. It can inspect large, horizontal reinforced concrete surfaces quickly, cost-effectively, and accurately. BetoScan currently has eight sensors that analyze the moisture and thickness of the concrete as well as the depth and condition of the reinforcement. The individual measuring methods have been long in use, but their integration into a single system is new. "This has the benefit that we can check several parameters of the surfaces at the same time," explains Dr. Jochen Kurz from Fraunhofer IZFP.

BetoScan examines the condition of concrete structures quickly and accurately – and can cover up to 100 m² in one day.
Photo: Fraunhofer IZFP

Detecting damage in good time

BetoScan can move across obstacle-free surfaces independently along a selected grid and is able to collect location-specific data. Contactless inspection devices can be used continuously. When contact sensors are used, inspections need to be carried out in a non-continuous mode. Measuring devices, the sensor platform, and the control unit are all linked to one another. The measuring results are organized in a database and are displayed to the user in the form of a graphic representation on the computer. The new type of inspection and evaluation system allows very large surfaces – several 100 m² per day – to be inspected at great surface measuring density. This means that damage can be detected in good time and repaired before larger and more expensive maintenance work is required.

The construction industry is taking notice

Currently, several test phases are taking place with a first prototype. The construction industry has already signaled great interest. A condition check will soon be due on many older buildings. The first BetoScan robots may soon be rolling through multi-story parking garages in Germany.

Photo: Jens Kracheel

BetoScan
BetoScan is a project from within the German Federal Ministry of Economics and Technology's funding program for innovative networks. In addition to Fraunhofer IZFP, the project partners include the Federal Institute for Materials Research and Testing; the Institute of Building Materials Research at RWTH Aachen University; Specht, Kalleja + Partner GmbH; GPS GmbH; Concrete Improvement Technologies GmbH; Germann Instruments; Acoustic Control Systems Ltd.; Arxes Information Design Berlin GmbH; IGF Ingenieur-Gesellschaft; and Sika Deutschland GmbH.

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