Andra Call for Projects
with the support of the
Investments for the Future Programme

DCND

Dynamic and Non-Destructive Testing

Project supported by Andra under the "Investments for the Future Programme" ("Investissements d'Avenir") - Selected under the Andra Call for Projects "Optimization of post-dismantling radioactive waste management", organized in cooperation with the French National Research Agency (ANR).

Duration: 36 months

Project launch:
02/2015

Total project cost: €1.17 million

Sum covered under the Investments for the Future Programme:
€449,000

Type of financial support: Subsidy

Locations: Aix (13), Marseille (13), Toulouse (31) and Bordeaux (33)

Coordinator:
CNRS Laboratory of Mechanics and Acoustics (CNRS LMA)

Partners:
- CNRS Laboratory of Mechanics and Acoustics, Aix-Marseille University
- Laboratory of Materials and Durability of Constructions (LMDC), Paul Sabatier University, Toulouse (UPS)
- Institute of Mechanics and Engineering, University of Bordeaux (I2M)

Contact: Vincent GARNIER
Vincent.Garnier@univ-amu.fr

BACKGROUND

On nuclear facility decommissioning sites, it is important to characterise the concrete structures which require dismantling (e.g. buildings) and the containers of radioactive waste produced. Knowing the state of integrity and mechanical characteristics of the concrete they are made of helps improve the safety and efficiency of decommissioning and then disposal operations.

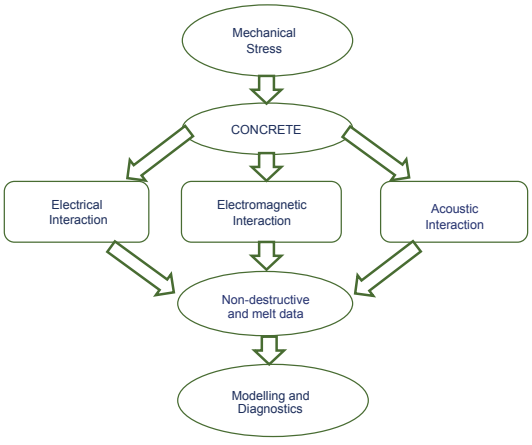
Implementing non-destructive testing (NDT) is a way of conducting large-range inspection operations without damaging materials, thereby limiting the duration and cost of testing.

The DCND project proposes an innovative Non Destructive Evaluation approach for characterising cement-based materials under various operating conditions.

OBJECTIVES

The objectives of the DCND project are as follows:

- studing to what extent the acoustic, electromagnetic and electric properties of concrete change under the effect of dynamic stress (e.g. mechanical vibrations). This change in the properties of concrete is already proven for low amplitude vibrations, but needs to be verified for greater amplitudes of stress, beyond the scope of conventional measures (non-linear scope);
- using these properties to develop a non-destructive evaluation technique which is more sensitive to the increase of the damage of cementitious materials (particularly cracking) than existing techniques;
- performing full-scale testing of the proposed methods on a concrete waste container demonstrator.



Approach adopted for the DCND project to assess the suitability of three non-destructive testing techniques for concrete.

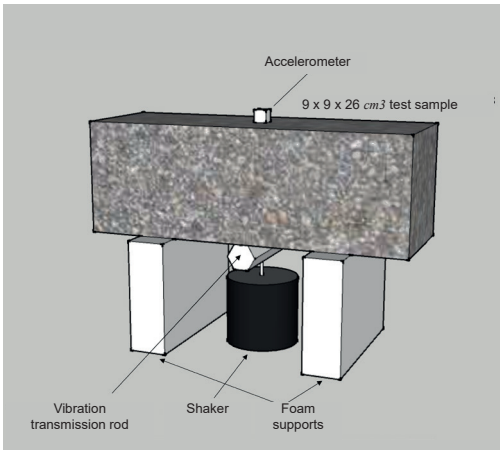
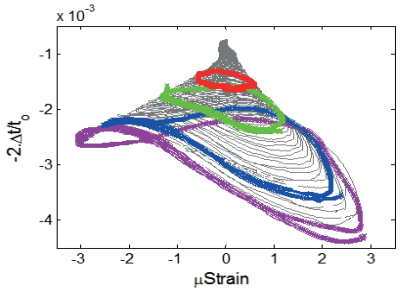


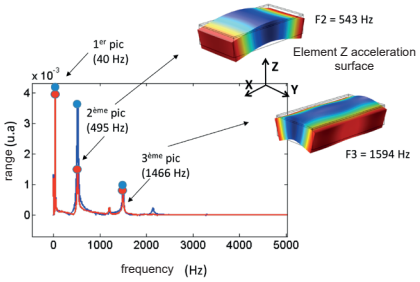
Diagram of a vibration test on a concrete beam.

Andra Call for Projects with the support of the **Investments for the Future Programme**

DCND: Dynamic and Non-Destructive Testing



Example of laboratory test results following the non linear behavior of a concrete beam using the DAET method (Dynamic Acousto-Elastic Testing).



Example of measurements of vibration modes of a concrete beam and comparison with structure strain calculations.

Mechanical stress test on a concrete container.

PROJECT SEQUENCE

The project is scheduled for a three-year period. Its three university partners are the CNRS LMA (Aix-Marseille), LMDC (Toulouse) and I2M (Bordeaux). Their complementary capabilities in non-destructive testing methods and materials will work together to achieve the project objectives.

EXPECTED RESULTS

The DCND project will make an especially useful contribution to the nuclear sector and all civil engineering departments, by developing a detailed diagnostics system for potential defects on concrete structures. It should lead to the ability to estimate the position, size and nature of any damage or cracks within concrete.

Innovation

The principle of dynamic stress testing on a material or structure has already proved it can improve the sensitivity of non-destructive testing, through ultrasonic testing. The innovative technology in the DCND project is two-fold:

- applying this principle to electromagnetic (radar) and electric waves;
- implementing it in real applications by developing a methodology and protocols of use.

Economic impact

Any innovation in non-destructive testing represents economic progress in civil engineering. Reducing the number of destructive tests to carry out reduces the costs and risks associated with taking samples from a structure. Inspecting a large area of the structure will give a more representative overview of testing, with greater sensitivity to signs of concrete ageing.

Impact on radioactive waste management

The DCND project seeks to improve:

- the safety of dismantling work during nuclear facility decommissioning;
- tests on the state of waste containers before they are sent off for disposal.

This will reduce the associated risks of environmental pollution and accidents involving personnel.

Social impact

The solutions proposed in the project are truly innovative. If it is possible to industrialise the procedure, new high-tech expertise will need to be developed, beyond just the nuclear sector, in industries such as civil engineering and inspection, both nationally and internationally.

APPLICATION AND COMMERCIALISATION

Dissemination of the solutions will require additional studies beyond those carried out for this project. Nevertheless, the testing and measurement principles developed under the DCND project could lead to the development of non-destructive testing tools that can be transported on sites and the creation of inspection robots. Diagnostics will be established with the support of experts specialised in this type of testing. In particular, the concerned profession are the civil engineering works testing and inspection. The actors of this sector are currently creating a working group within COFREND (French Confederation for Non-Destructive Testing) to standardise non-destructive testing protocols for civil engineering structures. This group will also support quick and efficient dissemination of the outcomes of the DCND.