LABORATÓRIO NACIONAL
DE ENGENHARIA CIVIL

TESTING
and METROLOGY

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number 5 December 2016

The Quality Management team of the LNEC-EM sends to all Colleagues and Friends votes of happy holidays and a year of 2017 full of health, successes and the continuation of cooperation sharing of of knowledge.

testing and metrology

8 June 2017

open day

newsletter

Reaction to fire tests of a façade cladding system of the new building of the MAAT

The Reaction to Fire Laboratory (URF) is part of the Building Finishes and Thermal Insulation Unit of LNEC´s Buildings Department.

URF had its genesis in the need for testing and to proceed to the classification of reaction to fire in accordance with national regulations fire safety, and fits, for over 30 years in the Department of Buildings LNEC.

Currently, the URF performs all relevant tests for the award of the European classification of reaction to fire products and building systems.

This laboratory is accredited by IPAC (Certificate No. L0488) and performs the fire reaction tests for which the LNEC is notified to the EC (NB 0856) by IPQ, under the Regulation of Construction Products (RPC):

- test ignitability; non-combustibility test; determination of the calorific value; determination of the burning behavior using a radiant heat source (floorings); test isolated element in combustion (SBI).

In addition to the tests that URF performs in support of the CE marking, the national approval (DH) and the technical evaluation (including European - ETA / ETA) products and systems / construction kits, offers abroad the possibility of holding tests, namely:

- testing services to the final allocation of a European reaction to fire classification; Indicative tests to assess the European potential of products or product families classification; trials to support the development or improvement of the reaction to fire performance of products; tests to support regular monitoring of production; test programs to support the development of indirect or simplified methods of testing for factory production control.

Under a recent study for approval of a façade cladding system (horizontal surfaces) applied in the new building of the **Museum of Art, Architecture and Technology (MAAT)**, URF made a set of tests for the award of the respective reaction class to fire. The system under evaluation consisted of a façade cladding with ventilated air space (ventilated façade) carried by ceramics pieces (gres) attached to aluminum profiles. In order to avoid falling accidentally broken ceramics fragments in the corresponding masonry face should be applied to a glass fiber network bonded to the ceramic. In order to prevent the rainwater passage to the interior of the ventilated air space should be created a one-watertight barrier, but vapor-permeable. The intervention of the URF had consisted in making various preliminary tests for assessing the fire performance of alternative options proposed, which allowed select the appropriate solutions (feature point of view study) for the network attachment adhesive and the barrier the flow of water to the interior. At the end they were performed standardized tests that led to the award of the reaction classification to the ventilated facade fire, satisfying the applicable regulatory requirements.

Formula SAE® Series

The Formula SAE® Series competitions challenge teams of university undergraduate and graduate students to conceive, design, develop and race with small, formula style vehicles. Formula SAE is an international engineering design competition for students. It began in U.S and today the competition is all over the globe, gathering more than 500 teams. Throughout the development of the prototype, students are called to work as a virtual small company, making this competition a testing ground for the next generation of world-class engineers.

Project FST Novabase is a Formula Student's team from Instituto Superior Técnico, University of Lisbon, since 2001, including students from mechanics, electronics, computers and aerospace engineering.

The actual car, with a 100 kW power, a carbon fiber monocoque, is the 4th vehicle built by the team and the first of an electrical era.

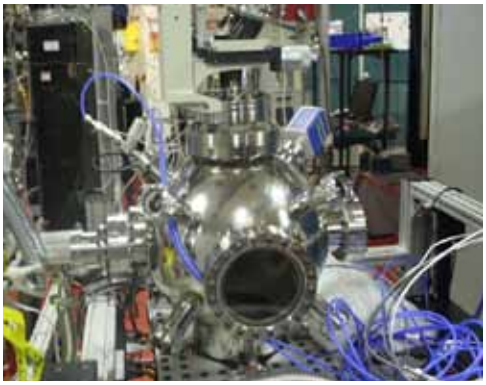
LNEC is one of around seven tens of sponsors and, via its Laboratory for Structures Aerodynamics – UADinE – provides wind tunnel testing for the aerodynamic parts characterization. The rear wing was tested for different angles and two configurations, according to the different competitions the team will attend.

Assessment of the Metrological Performance of Seismic Tables for a QMS Recognition

Seismic testing and analysis using large infrastructures, such as shaking tables and reaction walls, is performed worldwide requiring the use of complex instrumentation systems. To assure the accuracy of these systems, conformity assessment is needed to verify the compliance with standards and applications, and the Quality Management Systems (QMS) is being increasingly applied to domains where risk analysis is critical as a way to provide a formal recognition. This paper describes an approach to the assessment of the metrological performance of seismic shake tables as part of a QMS recognition, with the analysis of a case study of LNEC Seismic shake table.

From the collaboration between NESDE (Earthquake Engineering and Structural Dynamics Unit), Quality Management and NQM (Metrology Quality Division), competences were developed that enabled metrological tests and innovative research studies to be carried out in order to promote a metrological characterization of the system in its different measurement aspects, complying with the requirements of ISO / IEC 17025 that ensures technical competence of the entities

Main cyclotron of Berkeley laboratory



conducting experimental tests in a paper laboratory.

As a result of this work, it was presented at the University of California, Berkeley, in August of this year, a paper describing a new approach to the evaluation of the metrological performance of seismic vibration tables as part of a QMS recognition, based on thet applied collaboration in the content of the seismic platform of the LNEC´s Structures Department.

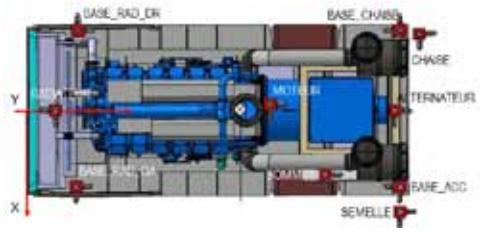
Molecular & Cell Biology, Lawrence Berkeley National Laboratory, University of California, Berkeley (2016)

Seismic qualification of equipment for the nuclear industry Fukushima Project, EDF and AREVA

The Structural Dynamics Laboratory (UDinE) is part of the Earthquake Engineering and Structural Dynamics Unit, which is integrated in LNEC's Structures Department, being equipped with the experimental infrastructures required for the development of R&D&I activities.

The main activity of UDinE consists of the characterization of the seismic behavior and vulnerability of large structures subjected to seismic actions of different intensities until imminent global collapse of structures or substructures.

LNEC´s-3D shake table, on which the models to be tested are placed and fixed, has the shape of a triangular prism with the following characteristics: dimensions (4,6 x 5,6) m^2; maximum capacity of 40 tons; three independent orthogonal axes; displacements controlled actively, and passively restricted rotation (torsion bars); frequency range of 0Hz up to 40 Hz.



This study was developed for SDMO and was monitored and validated by EDF, in accordance with the French standardization requirements for this context. In this process, UDinE had to highlight the application, in its experimental activity, of concepts and practices that are part of the Quality Management System (QMS) of LNEC-EM (accreditation support for LNEC-EM operational laboratories).

From the collaboration established between the NESDE (Earthquake Engineering and Structural Dynamics Unit), the Quality Management of the laboratories and the NQM (Metrology Quality Division), it was possible to establish a basis for the application of the QMS, namely, by introducing the traceability of Measurements, consolidating documental practices of equipment management and promoting the qualification of operators, among others, which was a great challenge for the time available. The successful completion of this activity showed the importance of cooperation between sectors in the LNEC, with a view to other future collaborations that could increase the capacity and competence of the industry.

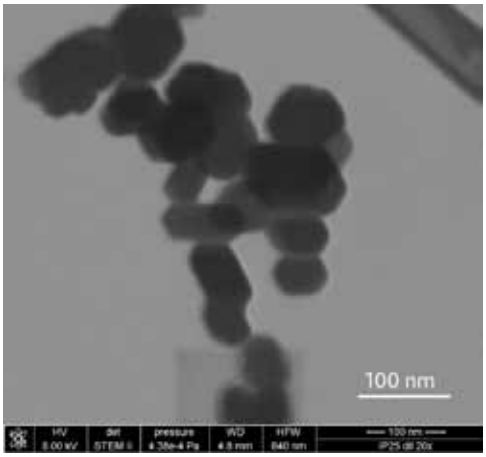
Nanostructured lime based materials for the conservation and restoration of historical stone and renders

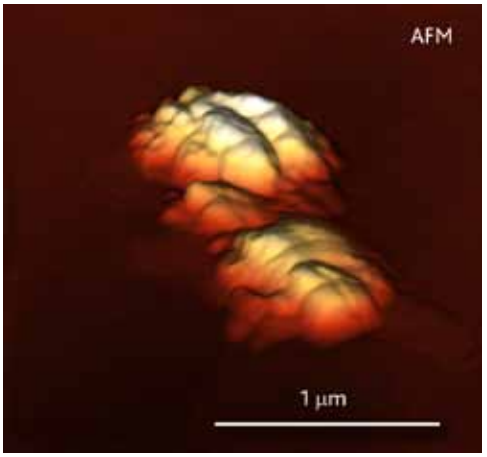
The support for the PhD thesis entitled "Nanostructured lime-based materials for the conservation and restoration of historical stone and renders" is underway at the Wall Coating Laboratory (URPa) of LNEC-EM. The main objetive of the thesis of the PhD student hosted by LNEC, Giovanni Borsoi, has as main objective the synthesis and optimization of nanocais for the consolidation of traditional building materials, such as lime-based and limestone-based coatings.

Nanocals are dispersions of nano-particles of calcium hydroxide in alcohols, which claim to be more effective than traditional consolidators in terms of physico-chemical compatibility and penetration depth.

The thesis is being developed at the University of Delft (The Netherlands) and in the TNO (The Netherlands), and has LNEC as the host institution.

URPa, which has participated in several projects aimed at the conservation of the built heritage (e.g. "Limecontech", "Azulejar" projects), has participated actively in the experimental work of that thesis, ensuring the preparation of mortar bases simulating coatings with low cohesion and the application of the nanocais in the mention bases.





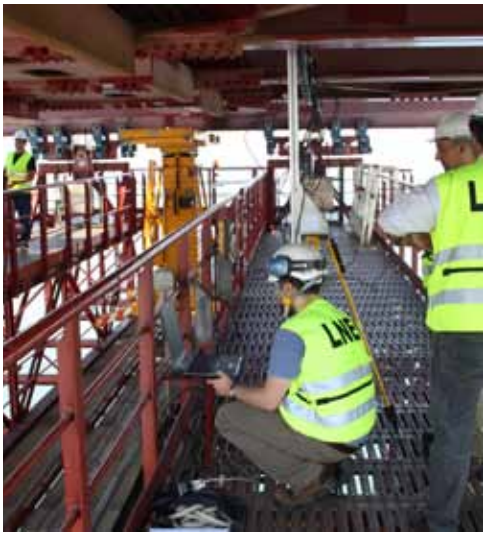
Innovation Award in Metrology

Luís Filipe Lages Martins is the winner of the 1st edition of the Innovation Prize in Metrology of the Portuguese Society of Metrology (SPMet). The first student to obtain a PhD in Physical Engineering from the Faculty of Sciences of the University of Lisbon received the award in November 2016, in Évora, during the CONFMET 2016.

This thesis was discussed with distinction in December 2015 and now distinguished by SPMet is entitled "Optical Metrology Applied to Dimensional Terrestrid Observation of Infrastructures in Dynamic Regime" and was advised by José Manuel Rebordão, professor of the FCUL´s Phisics Department co-advised by Álvaro Silva Ribeiro, head of the Metrology Quality Laboratory of the LNEC´s Scientific Instrumentation Center.

This work has the 25 de Abril Bridge as a case study and was funded by the Foundation for Science and Technology, through the award of a PhD grant, between 2011 and 2015, with the support of the Infraestruturas de Portugal.

The methodology and the instrumentation adopted in the scope of this investigation can be applied to any infrastructures whose static and dynamic monitoring is critical. Luis Filipe Lages Martins developed new methods to monitor the 25 de Abril Bridge using fiducial



light sources (in infrared) and computer vision systems; and instrumentation to place in the various components of this infrastructure, with great incidence in the determination of the uncertainties of the whole system, a critical aspect in any metrology system.

UBC - AEQ
Concrete and Cement Laboratory - Chemical Testing

Overview

The Concrete and Cement Laboratory - Chemical Testing (UBC - AEQ) is part of the Concrete, Stone and Ceramic Unit of the Materials Department of LNEC and has been created in 1997 to support the construction sector in relation to the assignment of cement conformity marking.

The activity carried out at UBC - AEQ falls within the LNEC strategy for Research, Development and Innovation (R&D&I), in particular with regard to the Built Heritage and Natural Resources.

Field of expertise

The UBC - AEQ develops accredited activity in the chemical characterization of the following materials:

- Cements;
- Coal fly ashes.

The area of activity of the UBC - AEQ extends to other materials among which aggregates, chemical admixtures, water, mortars and concretes are highlighted.

Testing

The UBC - AEQ performs, according to standard procedures, the following laboratory tests:

Cements

- Determination of loss on ignition;
- Determination of pozzolanicity for pozzolanic cement;
- Determination of potassium oxide content;
- Determination of sodium oxide content;
- Determination of residue insoluble. Sodium carbonate method;
- Determination of chloride content;
- Determination of sulphate content;
- Determination of heat of hydration. Semiadiabatic method.

Coal fly ashes

- Determination of free calcium oxide content by volumetry.

Other services

Featuring a qualified staff and a well equipped laboratory, UBC - AEQ, always giving priority to the quality of information provided and close cooperation with customers, also develops the following activities:

- Conduct research studies for the development of building materials incorporating waste and industrial by products;
- Carry out studies and provide technical advice in the context of internal expansive reactions of concrete – alkali aggregate reaction and internal sulphate reaction;
- Perform chemical characterization of construction materials and their constituents by qualitative and quantitative chemical analysis, using gravimetric, volumetric and instrumental methods (including WD-XRF, ICP-AES and GF-AAS), according to standard procedures or internal methods;
- Assess the release of dangerous substances through leaching tests on inorganic matrix materials to check the feasibility of its use in an environmental sustainability perspective;
- Carry out consultancy about building materials, especially cements, mortars and concretes;
- Collaborate in the elaboration of normative documents;
- Disseminate of knowledge through publications, namely reports and technical specifications.

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