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Assessing the corrosion of steel reinforcements embedded in concrete under different exposure conditions simulating field applications

Prof. Tiziano Bellezze

Department of Science and Engineering of Matter, Environment and Urban Planning (Dept. SIMAU) - www.univpm.it

UNIVERSITÀ POLITECNICA DELLE MARCHE

Supervisor: Prof. Tiziano Bellezze
Research Group Description

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Electrochemical corrosion measurements

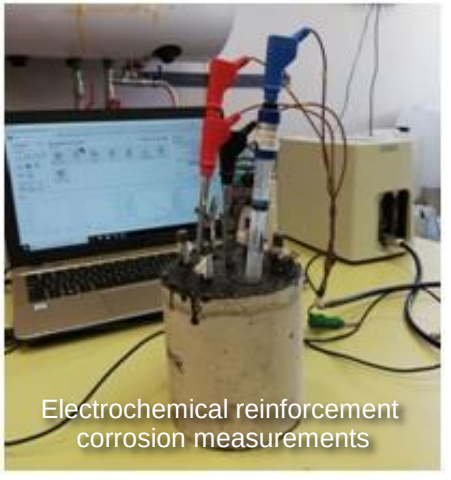
Head of Corrosion Laboratories of SIMAU Department

Tiziano Bellezze is Associate Professor in Science and Technology of Materials. In 2021, he obtained the National Scientific Qualification to the function of Full Professor in this field. Tiziano Bellezze makes a didactic activity on Corrosion and Materials; supervisor of BC, MD and PhD thesis in different Engineering fields. He gained an over 25 years' experience in studying corrosion and protection of metals. He participated to different national and international congresses and projects.

Research Group description and expertise

- *The Supervisor and a Technician, both with a long expertise in the corrosion field, and a PhD student;*
- *a Full Professor, a Researcher, another Technician and a PhD student with a well-established experience in corrosion of reinforcements, particularly if galvanized, as the Supervisor;*
- *a Full Professor and an Associate Professor with a long experience in the study of building materials, especially those cement-based.*

In the Department, there are laboratories where reinforced concrete/mortar specimens can be prepared and tested in terms of their mechanical, chemical-physical and microstructure properties. Over the years, even a significant experience has been gained in the formulation of specific mixes with new binders as alkali activated ones, paying attention to the recycle of industrial by-products.


Electrochemical reinforcement corrosion measurements

Supervisor: Prof. Tiziano Bellezze

Research Group Description

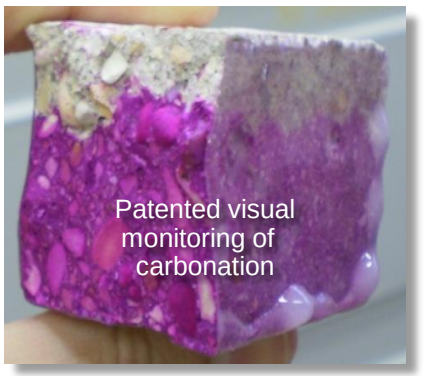
Concerning the study of corrosion resistance of metals, specific equipped laboratories are available with different modern models of Potentiostats/Galvanostats for carrying out electrochemical measurements in DC (as polarization resistance) and AC techniques (as Electrochemical Impedance Spectroscopy), for accessing reinforcement corrosion rates and then the durability of reinforced structures. In addition, there are also active/passive devices for generation and acquisition of signals for monitoring the characteristic parameters involved in corrosion phenomena. Therefore, customized experimentations can be performed with the possible development of specific probe prototypes.

Carbonation and salt spray chambers are available for the exposure of concrete/mortar specimens in harsh environments, as well.

Here the link for more details on infrastructures and instrumentations: https://simau.univpm.it/scienza-e-tecnologia-dei-materiali-laboratori-dei-settori-tematici/


Investigations with sensors

European fundings: "EnDurCrete - New Environmental friendly and Durable conCrete, integrating industrial by-products and hybrid systems, for civil, industrial and offshore applications“


Patented visual monitoring of carbonation


Carbonation chamber

Supervisor: Prof. Tiziano Bellezze

Department Description

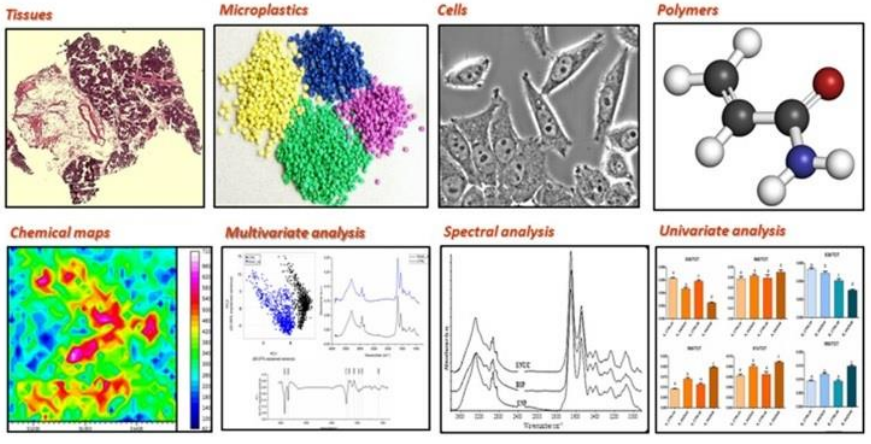
Department of Science and Engineering of Matter, Environment and Urban Planning (SIMAU)

(http://simau.univpm.it/)

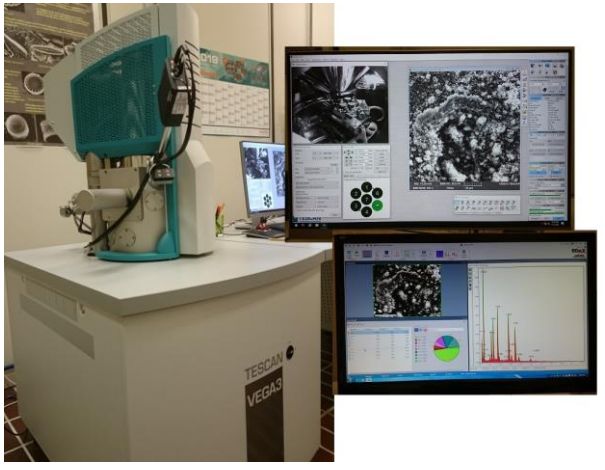
Structure in which the **confluence of different expertises** yield high-level teaching and high-profile international research in the field of **Science of Matter** and **Earth Sciences** with a special focus toward the **Environment**.

It operates within the **Engineering Faculty** offering teachers specialised in the so-called «hard sciences» (**Chemistry** and **Physics**) as well as theachers involved in more «applicative» fields, such as **Materials Engineering**, **Geotechnics**, **Geology**, **Environmental Engineering** and **Urban Planning**.

- **TECHNICAL ARCHITECTURE**
- **APPLIED GEOLOGY AND HYDROGEOLOGY**
- **ENVIRONMENTAL CHEMICAL ENGINEERING**
- **GEOTECHNICAL ENGINEERING**



Research Areas

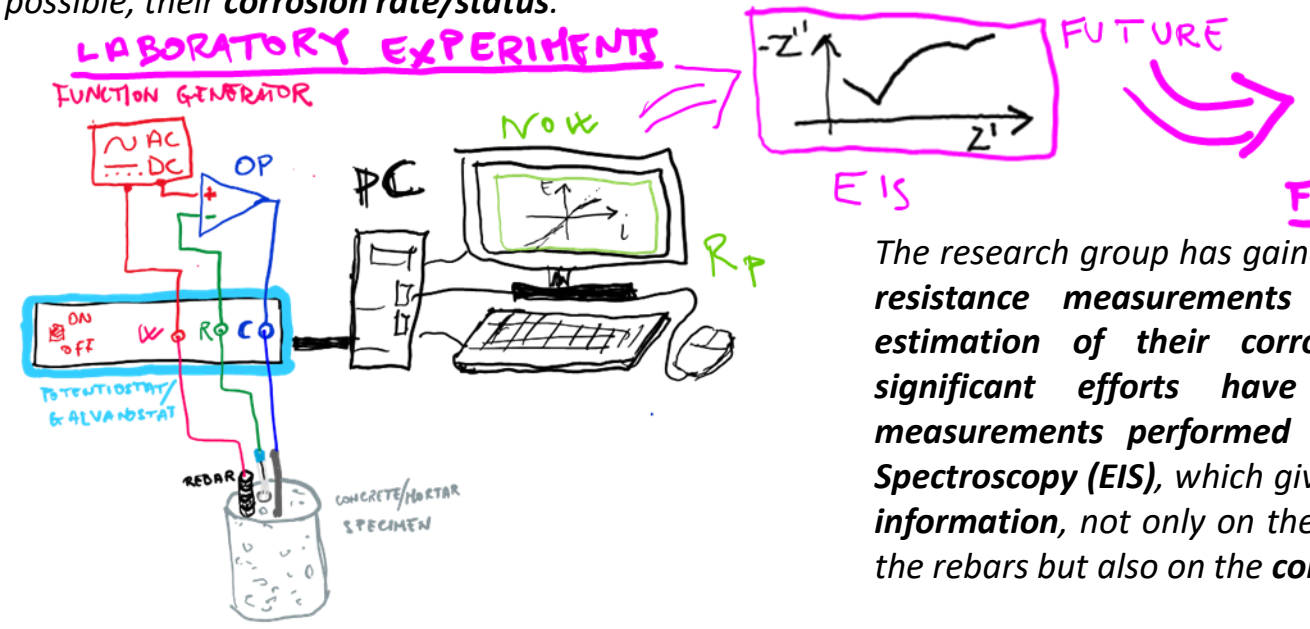


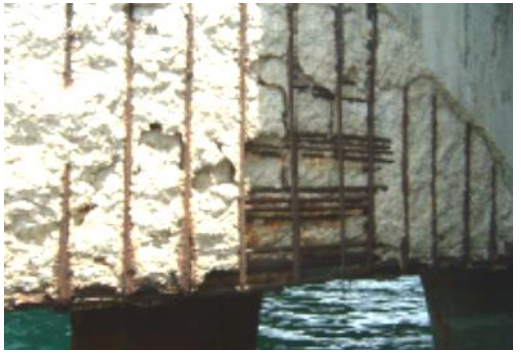
- **CHEMISTRY (ORGANIC)**
- **MATERIALS SCIENCE AND TECHNOLOGY**
- **EXPERIMENTAL PHYSICS**

Project Idea:

Assessing the corrosion of steel reinforcements embedded in concrete under different exposure conditions simulating field applications

*Considering the increasing interest of the scientific community on the **degradation of the concrete structures**, related to **reinforcements corrosion**, **the project is addressed to improve the measurement methods to estimate**, as accurately as possible, their **corrosion rate/status**.*





*The research group has gained experience in the **polarization resistance measurements of rebars** (R_p) and in the **estimation of their corrosion rate**. On the contrary, **significant efforts have never been dedicated to measurements performed by Electrochemical Impedance Spectroscopy (EIS)**, which gives the possibility **to obtain more information**, not only on the estimation of corrosion rates of the rebars but also on the **corrosion mechanisms**.*

*The project has the **main objective to manufacture laboratory reinforced specimens to set up the measurement methods**, interpretations and elaborations of data by using the typical approach based on equivalent circuits and/or developing new approaches.*

*The gained knowledge is necessary **to pave the way for extending these measurements in real reinforced structures**, by means of **innovative solutions for assessing their degradation**, **reducing maintenance costs** and, in particular, **to prevent loss of human lives**.*