Built environment control laboratory (RIAS)

Principal Investigator:
Prof. Antonio ROSATO

Responsible for teaching and research activities in the laboratory (R.a.d.o.r.):
Prof. Antonio ROSATO (proposal approved by the Department Council dated April 19th, 2021)

Location:
The laboratory is located on the ground floor of the Department of Architecture and Industrial Design (Abbazia di San Lorenzo ad Septimum, via San Lorenzo 4 - 81031, Aversa (CE), ITALY)

Main Laboratory Activities:
The "Built environment control laboratory" (RIAS) was born from the technical-scientific synergy of professors and researchers of the Department of Architecture and Industrial Design of the University of Campania Luigi Vanvitelli. It carries out teaching support activities, experimental research and studies based on numerical modelling/simulation. It provides services to other universities, public and private bodies, research organisations and companies, through laboratory and in situ tests as well as numerical analyses.
It includes the following 4 main research sectors:

- Acoustics and Vibrations
- Energy and Lighting
- Surveying, Representation and Communication of Architecture and the Environment
- Structures.

The main research activities of the above sectors are briefly described below.

"Acoustics and Vibrations" Sector:
The "Acoustics and Vibrations" sector mainly carries out theoretical, computational, experimental and design activities in the field of acoustics and vibrations. In particular, it deals with the measurement, analysis, numerical modelling and evaluation of vibro-acoustic problems in the environmental, architectural, construction, industrial and material fields in a traditional way.
The main activities can be summarized as follows:

- acoustic mapping and acoustic/vibrational monitoring;
- forecast assessment of the environmental impact of infrastructures and plants;
- assessment of exposure to noise and vibrations in the professional environment;
- development and characterization of eco-compatible materials for sound absorption, sound insulation and vibration damping;
- acoustic analysis and simulation of speech and music environments;
- acoustic analysis and simulation of ancient Greek-Roman theatres and historical opera houses;
- artificial intelligence (AI) and Noise Vibration and Harshness (NVH) applications for product end of line fault diagnosis in industry.

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"Energy and Lighting" Sector:

The "Energy and Lighting" sector can offer research and training activities on theoretical analysis, simulation, experimental tests and design in the field of solutions and systems, also based on non-programmable renewable sources, with high energy efficiency. In this perspective, different innovative components are analysed for energy efficient and sustainable applications. For example, the following main experimental activities are performed: (i) measurement of thermophysical properties (thermal conductivity, specific heat and thermal diffusivity) of building materials, (ii) evaluation of illuminance and luminance, (iii) characterization of artificial light sources in terms of correlated colour temperature, spectral power distribution and luminous intensity distribution (for small lighting sources), (iv) characterization of opaque surfaces in terms of visible reflection coefficient, colour and spectral reflectance, and (v) prototyping of facade elements. In addition, numerical activities carried out with reference to different applications, such as building-integrated systems, polygeneration plants, solar energy-based district heating/cooling systems integrated with seasonal thermal energy storages, short-term thermal energy storages, heating, ventilation and air-conditioning (HVAC) systems, energy, economic and environmental impacts associated to faults occurrence in HVAC systems, automated fault detection and diagnosis methods for HVAC systems, renewable energy communities, micro wind turbines, development of GIS tools, integrated natural and artificial lighting systems, 3D printed ventilated facade systems, development of low-cost measurement systems for environmental quality, integration of non-destructive monitoring systems on UAVs.

The most recent activities can be summarized as follows:

- dynamic simulation by means of the software TRNSYS of solar hybrid district heating and cooling systems based on the utilization of seasonal thermal storage upon varying the boundary conditions;
- development of dynamic simulation models using the software TRNSYS of HVAC systems;
- energy, environmental and economic assessment of different fault types at different levels of severity in HVAC systems upon varying the boundary conditions by using the software TRNSYS and artificial intelligence tecniques;
- development of methods for automated faults detection and diagnosis in HVAC systems by using the software TRNSYS and artificial intelligence tecniques;
- dynamic simulation of short-term thermal energy storages by using the software TRNSYS and artificial neural networks,;
- measurement of thermophysical properties (thermal conductivity, specific heat and thermal diffusivity) of materials;
- dynamic simulation, by using the software TRNSYS, of smart facades and ventilated walls/3D printed textile systems operating as second-skin for the energetic re-functionalization and visual communication of building facades;
- experimental analysis and dynamic simulation of solutions for the integration of artificial lighting/natural light through shielding systems and LED-based luminaires, using a Human Centric Lighting (HCL) approach;
- dynamic modeling and simulation of small-scale horizontal and vertical wind turbines upon varying the boundary conditions (wind turbine models and performance characteristics, climatic data, electric demand profiles, etc.) by using the software TRNSYS.

- dynamic modeling and simulation of renewable energy communities by using the software TRNSYS;
- development of GIS tools for the energy characterization of Mediterranean countries via the platform QGIS.

"Survey and Visualization of Architecture and Environment" Sector:

The activities carried out in the field of "Survey and Visualization of Architecture and Environment" are functional to the multiscale and multidimensional knowledge of the architecture and the environment both in terms of the careful gathering data and the visualization of them in the technical, educational and informative fields. It is about investigations concerning historical and/or contemporary assets.

The disciplinary skills can be summed up as follows by starting from the knowledge of scientific sources and analysis of technical-cultural trends:

- graphic analysis of architecture and environment;
- multidimensional survey of architecture and environment;
- representation of architectural and environmental data;
- database management and visualization;
- design of multimedia environments.

"Structures" Sector:

The sector is able to offer research and training activities in numerical analysis, experimentation and design in the field of seismic safety, structural adjustment, consolidation and static restoration of artefacts and infrastructures. In particular, it deals with the design, processing and experimental verification of the most appropriate solutions, and/or targeted research actions, using the results obtained through specific laboratory equipment.

The main activities can be summarized as follows:

- theoretical and experimental behaviour of masonry structures;
- experimental behaviour and damage to reinforced concrete structures;
- analysis of steel structures and seismic protection techniques of structures through metal devices;
- analysis of wooden structures;
- survey and vulnerability of cultural assets (churches, large statues, archaeological sites);
- testing of isolation devices at the base;
- evaluation of the deterioration of the structures;
- materials and techniques for the consolidation of structures.

Main Equipment:

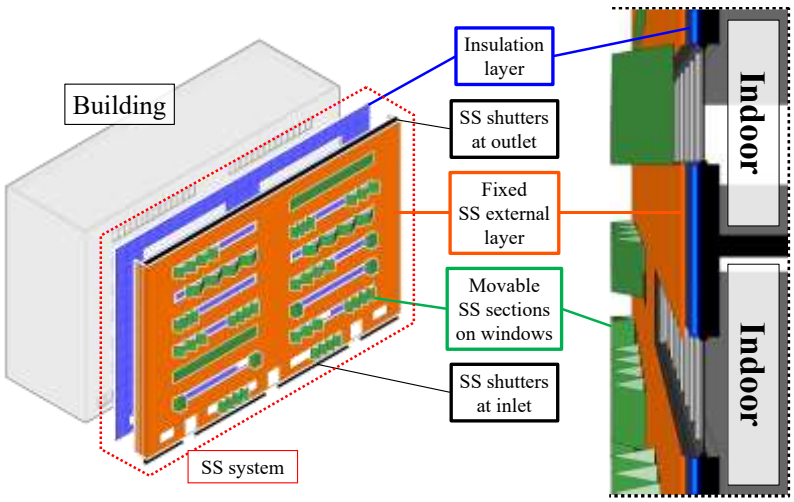
"Acoustics and Vibration" Sector:

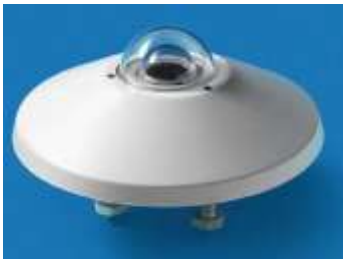
- System for determining the elastic modulus and damping SCS 9021. Oberst Method;
- System for the determination of the damping factor SCS 9022. SAE method;
- System for determining the flow resistance of porous materials (ISO standard) SCS 9023;
- Dosimeter Wed 007 01dB;
- Whole body accelerometer. Whole Body Vibration Set AP5211;
- Hand / Arm accelerometer. Hand/Arm Adapter Set AP5221/3;
- Outdoor acoustic modelling and forecasting software SOUNDPLAN;

- Modelling software for architectural acoustics ODEON.

“Energy and Lighting” Sector:

- Darkroom for photometric characterization of small lighting devices;
- Luminance meter;
- Multi-head luxmeter;
- Video photo meter;
- Spectroradiometer;
- Wearable spectroradiometer;
- Spectrophotometer;
- Hot Disk Thermal Constants Analyser (based on Transient Plane Source method)
- Volumetric liquid flow meter;
- Pt100 resistance thermometer;
- Volt-amperometric probes;
- Heat flow meter;
- Thermal Imaging Camera;
- Digital thermo-hygrometer;
- Hotwire anemometer;
- Globethermometer;
- Microclimatic station for solar radiation detection and meteorological conditions (includes Wind speed sensor, Wind direction sensor, Barometer, Thermo-hygrometer, Pyranometer);
- Modeling and energy analysis software: TRNSYS 18;
- Modeling software and lighting analysis: RADIANCE, DaySIM, DIALux, ClimateStudio;
- 3D printers DA VINCI SUPER and BAMBULAB X1E.





<u>"Survey and Visualization of Architecture and Environment" Sector:</u>

- Camera lens - Nikon - Nikkor F. Afd. 35 mmf/2D;
- Camera lens - Nikon - Nikkor F. Afd. 50 mmf/1.4D;
- Camera lens - Nikon - Nikkor F. Afd. 70-80mmf/4.5-5.6D;
- Camera lens - SIGMA - AF-MF ZOOM LENS. 15.30mm F3.5-4.5 EX DG ASPHERICAL;
- Camera - Nikon - F70;
- Camera - Nikon - Digital Camera E3/E3s;
- Camera - KUJIFILM - FinePix S2 Pro;
- Laser distance meter - Leica - DistoTM pro4;
- Laser distance meter - Leica - AG Heerbrugg;
- GPS Total Station - Trimble Navigation - TRM 5700;
- GPS Receiver - Trimble - TRM 5700;
- Mobile support - Manfrotto;
- Prism total station - NIKON - 6402;
- Protective glasses - Crystal EYES - Stereographics;
- Batteries - Leica - GEB70;
- Tricuspid/prism adapter/battery charger (forced centering) - NIKON - DTM-720;
- Counterbalance;
- Total Station - NIKON - DTM-720;
- Batteries - Leica - GKL23;
- Telescopic rod (2 m) with topoghaphical base - Trimble;
- Telescopic rod with circular topographic base up to 5 m (x2);
- Topographical tripods (x5) - NIKON;
- Photographic tripods - Trimble;
- Photographic tripods - Manfrotto - 132XN;
- Thopographical ranging pole (1.30 m);

- Total station – Leica - Model TS460.

“Structures” Sector:

- N. 4 accelerometers for the monitoring of buildings and infrastuctures;
- N. 2 displacement transducers LVDT;
- Control unit for aquisition data.

Associated Research Groups

- ACOUVI - Acoustics, Vibration and Multisensory Interactions;
- E3 - Energy Efficiency & Environment;
- ALERT - DigitAl knowLEdge and valoRisation of cultural heriTage;
- REST - REsilience of STructures;
- CNBe - Carbon Neutral Built Environment.

Reference Scientific Subject Areas:

IIND-07/B; IIND-07/A; 08/CEAR-10/A; 08/CEAR-06/A; 08/CEAR-07/A; 08/CEAR-08/C.

ISI WEB categories:

- Computer Science, Software Engineering;
- Engineering, Environmental;
- Engineering, Multidisciplinary;
- Acoustics;
- Physics, Multidisciplinary;

- Engineering, Manufacturing;
- Public, Environmental & Occupational Health;
- Computer Science, Artificial Intelligence;
- Computer Science, Hardware & Architecture;
- Urban Studies;
- Education & Educational Research;
- Architecture;
- Communication;
- Construction & Building Technology;
- Engineering, Civil;
- Engineering, Mechanical;
- Engineering, Multidisciplinary;
- Humanities, Multidisciplinary;
- Materials Science, Characterization & Testing;
- Materials Science, Composites.

ERC categories:

- PE2_15 - Thermodynamics
- PE6_1 - Computer architecture, embedded systems, operating systems
- PE6_9 - Human computer interaction and interface, visualization
- PE6_12 - Scientific computing, simulation and modelling tools
- PE7_3 - Simulation engineering and modelling
- PE8_3 Civil engineering, architecture, offshore construction, lightweight construction, geotechnics
- PE8_6 - Energy processes engineering
- PE8_11 - Environmental engineering, e.g. sustainable design, waste and water treatment, recycling, regeneration or recovery of compounds, carbon capture & storage
- SH1_13 Human resource management; organisational behaviourSH3_10 Communication and information, networks, media
- SH8_8 Visual and performing arts, screen, arts-based research
- SH8_5 History of art and of architecture
- SH8_4 Museums, exhibitions, conservation and restoration
- SH8_3 Cultural studies and theory, cultural identities and memories, cultural heritage
- SH7_5 Sustainability sciences, environment and resources, ecosystem services.

Keywords:

<u>"Acoustics and Vibration" Sector:</u>

Acoustic; vibrations; sound absorption; metamaterials; acoustic impact; architectural acoustics.

<u>"Energy and Lighting" Sector:</u>

Architecture; sustainability; energy; buildings; energy saving; environmental and economic impacts; solar energy; district heating and cooling; seasonal thermal energy storage; short-term thermal energy storage; HVAC systems; thermophysical properties of materials, fault detection and diagnosis; small-scale wind turbines; renewable energy community; TRNSYS; QGIS; neural networks; lighting; smart facades; smart windows; daylighting; LED.

<u>"Survey and Visualization of Architecture and Environment" Sector:</u>
Cultural heritage; survey and representation of architecture and environment; indirect survey by means of aerial and terrestrial photogrammetry.

<u>"Structures" Sector:</u>
Analysis and test of structures; earthquake engineering; masonry structures; reinforced concrete structures; steel structures; wooden structures; seismic protection techniques and systems; vulnerability of structures; degradation of materials; monitoring of structures; seismic adjustment and improvement of structures; materials for the consolidation of structures; masonry structures; architectural and environmental drawing; remote sensing, architectural survey.

Laboratory certifications:
UNI EN ISO 9001: 2015

Sector:
IAF 35-34

First certification:
24 May 2007

Last certification:
Certificate n. 374aSGQ15 dated July 17th, 2024

Field of application:
Multidisciplinary design and services for technical advice, research and teaching support to manage and control the built environment.

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Operative Unit

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per il seguente Servizio
concerning the following Service

Progettazione ed erogazione di servizi multidisciplinari di consulenza, ricerca, supporto alla didattica e prestazioni di servizi per il controllo dell'ambiente costruito

Multidisciplinary design and services for technical advice, research and teaching support to manage and control the built environment

è conforme alla norma
is in compliance with the standard

UNI EN ISO 9001-2015 (ISO 9001-2015)

Il presente Certificato è soggetto al rispetto delle condizioni stabilite dai Regolamenti per la Certificazione in vigore applicabili.
This Certificate shall satisfy the requirements established in the Rules for the certification in force applicable.

La validità del presente certificato è vincolata a quella del certificato n. 374SGQ16
The validity of this certificate is bound by the certificate 374SGQ16

In caso di discordanza tra le lingue utilizzate nella traduzione del contenuto del presente certificato, fare riferimento alla lingua italiana
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L'AMMINISTRATORE DELEGATO
MANAGING DIRECTOR

Dr. Ing. Roberto Cusolito

Data di Prima Emissione *First Issue Date*	Data di Modifica *Modified Date*	Data di Scadenza *Expiry Date*
2007-05-24	2024-07-17	2025-05-23

Settore IAF 34 - 35

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