The **Built Environment Control Laboratory** of the Department of Architecture and Industrial Design "Luigi Vanvitelli" - Second University of Naples (Italy), was established by a group of researchers working on different research fields (ecogeometry, environmental control, structures) to integrate competences and equipments.
The laboratory aims to promote interdisciplinary research projects on the *built environment* and to give support to the University Departments as well as public and private companies.

The ***Energy efficient Building - EeB Research Team*** is able to cover research activities, both from theoretical and experimental sides, on:

- Environmental and Energetic Design of a Precast Concrete Panel
- Micropolygeneration and Gas Engine Heat Pump
- Design of daylighting and artificial lighting system (LED for outdoor, roadway, indoor,..);
- Design and assessment of daylighting and fenestration systems.
- Solar cooling in historical building

For the different activities are available several facilities and advanced equipments (illuminance-meter, luminance-meter, videoluminacemeter, heatflux meter, artificial sky, IR camera, temperature sensors,....) for in situ and laboratory measurements as well as software (TRNSYS, Comsol multiphysics, Ecotect, Radiance, AGI 32, DIALux) for building performance simulation and lighting design.

Environmental and Energetic Design of a Precast Concrete Panel

The research project aims to improve energetic and thermal performances of concrete precast panels that are used in industrial building cladding and in several applications of tertiary sector (e.g. commercial building, warehouse, office,..).
The panel system under study is employed in an industrial building located in the southern part of Italy, and a set of data regarding the thermo-hygrometric and energetic performance of the single panel and the whole building, have been acquired.
External conditions (temperature, humidity, wind direction, solar radiation, illumination) and internal conditions (temperature, humidity, illumination) have been collected and then compared to software simulation results (Ecotect,TRNSYS).
This leads to the effective information on main parameters that are influencing actual panel and so they can define requirements necessary to improve energetic performance in term of thermophysical performances (thermal resistance, lower water vapour diffusivity, optimization of thermal lag and enhancement of energy savings).

Micropolygeneration

The laboratory is equipped in order to experimentally investigate the MCHP unit under different operating conditions (electric/thermal load profiles, cooling water flow rates, cooling water temperature, operating strategy, etc).
A software for the remote central control and thermo-economic optimization of a virtual laboratory, called "PoliLab", consisting of two polygeneration systems placed in Regione Campania (Second University of Naples and Sannio University) has been developed, in a "Virtual Power Plant" approach.
Activities have been developed in the framework of national (Ricerca di Sistema Elettrico, supported by Ministry of Economic Development) and international ("IEA-Annex 42" and "IEA-Annex 54") research projects.
For the components considered the suitable TRNSYS Types have been derived and calibrated.
A Gas engine driven Heat Pump (GHP) with a rated cooling power of 56 kW and a rated heating power of 67 kW is well instrumented in order to experimentally asses its performance upon varying the laboratory energy needs and atmospheric condition during both winter and summer.

LED technologies

The activity is focused on the development and the implementation of luminaire prototypes using LED sources for outdoor and road lighting within a research project leads by a display manufacturing company (TELENIA srl) and funded by Italian Ministry of Economic Development. The R&D started with a review of luminaires using LED sources available on the market, proposals of new "concept design" with the definition of geometrical and photometrical characteristics of the proposed products. To ensure an high efficiency of the new systems, different type of LED's and different auxiliary optics have been analyzed by thermal/photometric simulation and laboratory measurement. Furthermore, it has been evaluated the possibility to integrate the LED luminaires with photovoltaic systems and wireless communication network. Finally the possibility to integrate the LED sources with a photovoltaic module in the graphic and video applications and the possibility to use the LED displays and LED lighting for architectural integration has been considered too.

Energy assessment of outdoor lighting systems

The research has been issued by a scientific research agreement with the Department of Engineering of Sannio University that has carried out an extensive survey and a proposal for the energy saving of an industrial district. The activity consisted in an on-site measurement of the outdoor lighting systems within 12 industrial areas; the mapping of the present situation, with an extensive on-site measurement and evaluation, constituted the basis for the improvement of energetic efficiency of outdoor lighting system of the district. To support the process it has been suggested a methodology based on three stages (Initial audit, assessment of Performance Index and proposal for the energy efficiency improvement). The methodology provided for the support during the acquisition of qualitative and quantitative information about the outdoor lighting systems, the definition of the main parameters for comparing different areas and for identifying the best applicable intervention for each area.

Light pipes application

In order to assess the daylighting contribution related to the application of a light pipe in a residential building, an experimental measurement system has been set-up and investigated on-site considering a NZEB building

(LOCCIONI, Leaf House) located near Ancona, in the north of Italy; this represents a laboratory for new clean energy technologies. Illuminance sensors have been placed in vertical and horizontal position inside the room and near to the inlet of light pipe to evaluate the efficiency of the system upon varying sun illuminance during the day. To investigate the indoor daylighting distribution it has also been acquired the interior luminance distribution by a Team LMK 98-3 video-photometer.

Scale model daylighting assessment

The research is developed involving scale model measurement in a mirror sky box (under CIE standard overcast distribution) and its comparison with a computer simulation software "Ecotect" and Radiance; the last supplying the opportunity of evaluating and comparing the internal surface luminance distribution. Unlike other prediction tools daylighting models have the advantages of seeing and evaluating the daylighting both qualitatively and quantitatively, modelling spaces with complex geometries.

Solar cooling in historical building

In this proposed project it has been designed a solar heating and cooling plant for the Architecture Department of Second University of Naples located in a abbey complex built at the end of tenth century; the proposal took into account the historical and architectural content of the building hosting the Department, the air conditioning plant has been designed in order to conciliate the employment of renewable energy with both respect for historical heritage and protection of the landscape.
A new air conditioning system has been designed with the main aims to save energy and reduce greenhouse gas emissions. The design of the system has been carried out in order to get the best integration between the plant components and the architectural constraints. The new proposed air conditioning system is composed by two main subsystems:

- solar cooling and heating plant with absorption chiller;
- solar cooling plant whit desiccant wheel.

The main aim of the project is promoting solar cooling and heating installations that facilitate the discovery of visual integrations and good compromises between technical and architectonic features.

Measurement equipments

Experimental measurements are very important to understand the efficiency and the operation conditions of a lighting systems and for calibrating and validating detailed dynamic simulation models by means of simulation programs.
Many equipments are available for in situ and lab measurement:

- Mirror Box artificial sky
- HPD Model 126 Heliodon (Sun Emulator) for the visualization and calculation of solar effects
- Camera for scale model interior view "Toshiba IK.M51H" & Camera control unit D6 "Toshiba IK-CU51.
- Multichannel current/voltage converter "Krochmann Iph/U"
- Photometric heads for scale model measurement "Krochmann Model MI"
- Videoluminancemeter "LMK 98-3 Color"
- Spectrophotometer "Minolta CM-2600d"
- Spectroradiometer "Minolta CS-1000A"
- Luxmeter "Minolta illuminance meter T - 10" + Minolta Multipoint
- Incident color meter "Minolta chroma meter CL - 200"
- Luminance meter "Minolta luminance meter LS - 110"
- Mass flow sensor for methane,
- Ultrasonic mass flow sensor for water,
- Temperature sensors, model TT-227/Pt100,
- Watt-meters with measuring range 0-6 kW,
- Watt-meters with measuring range 0-10 kW,
- Exhaust gas analyzer.
- Babuc wireless datalogger unit
- External global radiometer
- External luxmeter
- External thermohygrometer
- Two heat flux sensors Hukseflux
- Infrared camera NEC TH7102WL

DIPARTIMENTO DI ARCHITETTURA E DISEGNO INDUSTRIALE
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