ENI CBCMED
Cooperating across borders in the Mediterranean

Project funded by the EUROPEAN UNION

REGIONE AUTÒNOMA DE SARDIGNA
REGIONE AUTONOMA DELLA SARDEGNA

UNIVERSITÀ DEGLI STUDI FIRENZE
DIDA Dipartimento di Architettura

Med-EcoSuRe

# Med-EcoSuRe Mediterranean University as Catalyst for Eco Sustainable Renovation

# Energy Audit: Data collection and recommendations

**Institute**: Università degli Studi di Firenze – UNIFI

**Building complex**: Architecture Faculty building complex of Santa Verdiana

FLORENCE, Italy
August, 2020

## Scope

The innovative idea of MED EcoSuRe Mediterranean cross-border living lab is to develop virtual and physical tools top stimulates participatory processes, supporting asset management with facility management innovative tools and strategies, enhancing their capability to plan and implement sustainable strategies and technologies among the different Mediterranean climatic contexts.

The project addresses the challenge to reduce urban/building carbon footprint and natural resources wastes and to drive it through into reality. A comprehensive reduction in urban emissions requires an increased focus on transforming energy use in buildings, as well as a shift from fossil fuels to renewable energy sources. It also requires a holistic approach to the energy efficiency of the built infrastructure operation.

## Objective

The main scope of the activity of Energy Audit is to understand the current conditions of the building, considering both the physical conditions and the energy consumption factors. This in order to understand, evaluate and determine which are the most critical aspects or which/where could be the most effective actions to propose and implement innovative and eco-sustainable energy renovation solutions.

## Current Building conditions

The building conditions are acceptable being a very old building which has suffered lots of changes. The last major modifications took place in 1986 when the building became the Architecture Faculty of the Florence University (UNIFI). Since then few modifications have been taking place in order to keep track of the contemporary life requirements.

Considering that the complex has a medieval origin, most of the interior spaces have thick walls with small openings and volume heights are generous in most of the cases. Due to the small openings, most of the spaces, mostly classrooms, are not well illuminated with natural light and lack of natural ventilation. In terms of comfort and wellbeing during the winter time the spaces are well known for being cold, on the other hand, during the summer period the rooms on the higher

levels do overheat rapidly, making these spaces nearly impossible to be used. Air quality is often bad, because there is no natural or mechanical ventilation; during winter windows are kept close in order to keep the heat loads inside the rooms and in summer there is not enough airflow to change the air volume of most of the classrooms.

The entire building has a heating system, most of it has a traditional Gas Heating System with radiators and only few spaces have an electric system with heat pumps and fan-coils for heating and conditioning supply. These spaces are: the reception, 4 teachers' rooms, printers' room, BIM Lab room, 2 classrooms (n°18 and 19), President's room and students' room.

In general, the building envelope is not insulated in the opaque components, both vertical and horizontal, nor in the transparent ones, since most of the glazing elements are single glass leaf with a metallic non thermal break frame.

Windows are not protected from solar radiation, causing greenhouse effect, especially in the spaces with north-south orientation. The complex of Santa Verdiana is protected as a heritage building and there is no way to introduce external elements that may affect the historical aspects/quality of the building.

There are only a few rooms with presence-sensors installed to turn on and off lights inside the rooms, most of the building spaces (classrooms, offices and common areas) have fluorescent fittings and few interior spaces and exterior common areas do have halogen fittings. In the rooms the lighting system is manually operated and depends on good sense of teachers and students to turn off lighting once the lessons are finished, the common spaces are commanded manually form the reception and in some areas are on during the entire opening hours.

## Pilot rooms current conditions

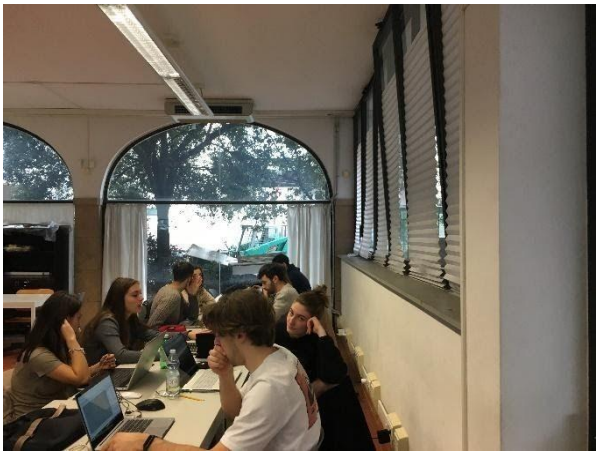
The rooms where the pilot project will take place are part of a two-story building with a north-south orientation, composed by the President's room and the students' room at the ground floor and a master classroom on the floor above. The current conditions are acceptable being a recent structure done at the last modification in 1986. It is a concrete structure building with a plastered tuff envelope, single glass leaf with a metallic non thermal break frame.

The rooms on the ground floor, less in the upper story, have a large amount of glazing exposed to the south that generates a greenhouse effect due to the radiation load gains. Circumstance that reveals critical from March to November, causing overheating inside the rooms. On the other hand, during the coldest days the large transparent components drive a major heat loss. Even in the presence of many windows there is no ventilation during winter enclosing poor air quality constantly, while in summer time the hot air coming from the outside determines uncomfortable conditions.

There are no shadings to protect from solar radiation, in the upper level semi transparent films have been applied to the glasses in order to control the glare effect.

In the interior of the spaces the lighting conditions are not ideal: in the lower level, there is too much light and in sunny days glare is a constant, while in the upper level natural lighting is quite low, specially in the central zone of the classroom, even if there is a sort of continuous façade in both south and north façades. Fluorescent lighting has to be turned on, during day hours, to achieve adequate lighting levels.

These rooms are part of the few areas of the entire complex that have an electric mechanical system for heating and conditioning, manually controlled by anyone with a thermostat placed inside the rooms. In any case there is a known people's complaint of how the upper level rooms are overheated from mid-spring till mid-autumn. And during the winter period the absence of an isolated roof concedes a heat loss through its surface. Heating and conditioning systems are inefficient, demanding a high energy consumption and supplying poor internal conditions in terms of temperature, air quality, $CO_2$ percentage present on air.



## Energy performance recommendations

In order to improve energy performance and reduce energy wastes during normal operation of Santa Verdiana building complex recommendations after data collection are the following:

- Changing lighting fluorescent and halogen fittings for more efficient lighting fittings;
- Introduce automatic controls to turn on/off lighting appliances when necessary;
- Find and introduce a way to control direct solar radiation in accordance with the exterior climate conditions;
- Changing existing windows with double glass and thermal break frame windows;
- Introduction of an air heat recovery system, to change air during the winter season;
- Envelope insulation strategy for the opaque components (walls and roof)
- Introduce heating and conditioning automatic controls;
- Introduce automatic window openings to ventilate naturally rooms when air conditions are not optimal;
- Take advantage of the building orientation for PV energy production;
- Consider to change the mechanical devices (heat pump and fan-coils) for more efficient ones;
- Introduce guideline/protocol and dissemination strategies to drive a better end-users behaviors;
- Monitor (IoT) external and interior conditions to integrate a more efficient automation system;

# Annex: Energy audit – collected data