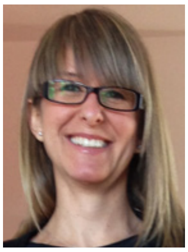
# A harmonized database to share nZEBs good practices



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A Rehva Task Force and an Italian Aicarr teamwork have developed a detailed database in order to share data of high performing buildings in Mediterranean climate. This database could be a fundamental tool to spread and engage the good practices to reach ZEB goals on a wide scale.

**Keywords:** database, nZEB, good practices, energy retrofit.

## The European framework

Nowadays in the European framework the good practices of retrofitted high performing building, passive houses and energy efficient buildings are copious, but what emerges is the lack of information and data sharing about them. There are indeed no official sources for data deriving from this kind of building and, moreover, there is shortage of quantitative and comparable data. In a process oriented to a large-scale diffusion of nZEBs on the market, the existing good practices of retrofitted high performing buildings should be kept as market benchmarks and reveal to be precious sources of information. In the light of the above, the need of a harmonized database to collect and share data deriving from different case studies, building typologies and climate zones plays a fundamental role. Starting from the sharing of envelope technologies and system solutions, the creation of a database could reveal to be a crucial tool to spread and engage the good practices to reach ZEB goals on a wide scale. Up to now various practices attempting to collect data about nZEBs can be identified. Within this beginner development of databases, it is possible to identify two principal kinds of them related to two different levels of data collection. A first type database, which collects general information about a great number of buildings (requiring few and perfunctory information), reveals to be useful to provide statistical overviews at a large-scale. While a second type database collects data (regarding to the climate conditions, envelope, systems and operational parameters) of single building in a detailed way so that the energy modelling could be performed. However, due to the weakness of the existing databases and to the necessity of having practical guidelines to design nZEBs, at the European level, a current REHVA task force and, at the Italian level, an Aicarr teamwork are targeting the development of a design guide for nZEBs in Mediterranean region, based on different national experiences. In order to reach this target, they have created a second type database, useful to collect and share detailed information about single high performing buildings, with the aim of filling the lack of quantitative and comparable information, in a process towards nZEBs diffusion. The main purpose is to record nZEBs, which have been already built, with available monitored data and that represent concrete models for future designing. The present paper illustrates the structure of this database. Because of the still scarcity of monitored nZEBs, the shown database is suitable not only for realized monitored buildings but also for those that are still in a design phase.

## The structure of the database

The database was developed as a MS Office Excel tool in order to be easily modified and implemented, covering most of the building typologies and features. Indeed, the format as it is allows collecting data both of new and existing buildings (monitored or not), belonging to different categories of end uses in order to be used for the whole building stock. As aforementioned, this database corresponds to the second type and requires many detailed information of the building; with this kind of data it is possible to develop an energy model of the building for a dynamic energy simulation.

The database is made of seventeen thematic sections, each one corresponding to a different spreadsheet, as shown in **Table 1**.

**Table 1.** Thematic sections of the database.

| | |
|---|---|
| 1 | General information |
| 2 | Geometrical data |
| 3 | Building envelope |
| 4 | Building system |
| 5 | Space Heating System |
| 6 | Space Cooling System |
| 7 | DHW System |
| 8 | Storage |
| 9 | Ventilation |
| 10 | Lighting & Appliances |
| 11 | RESs |
| 12 | Energy Calculated Data |
| 13 | Energy Monitored Data |
| 14 | Conversion factors |
| 15 | Economic valuation |
| 16 | Sustainable and green features |
| 17 | References |

Each section is structured in different consecutive columns (**Figure 1**). In the first column, the required information is reported; in the second one, the instructions detail precisely which kind of data is necessary to specify; in the third one, there is the space to fill in the data; in the fourth one, a space for notes is provided.

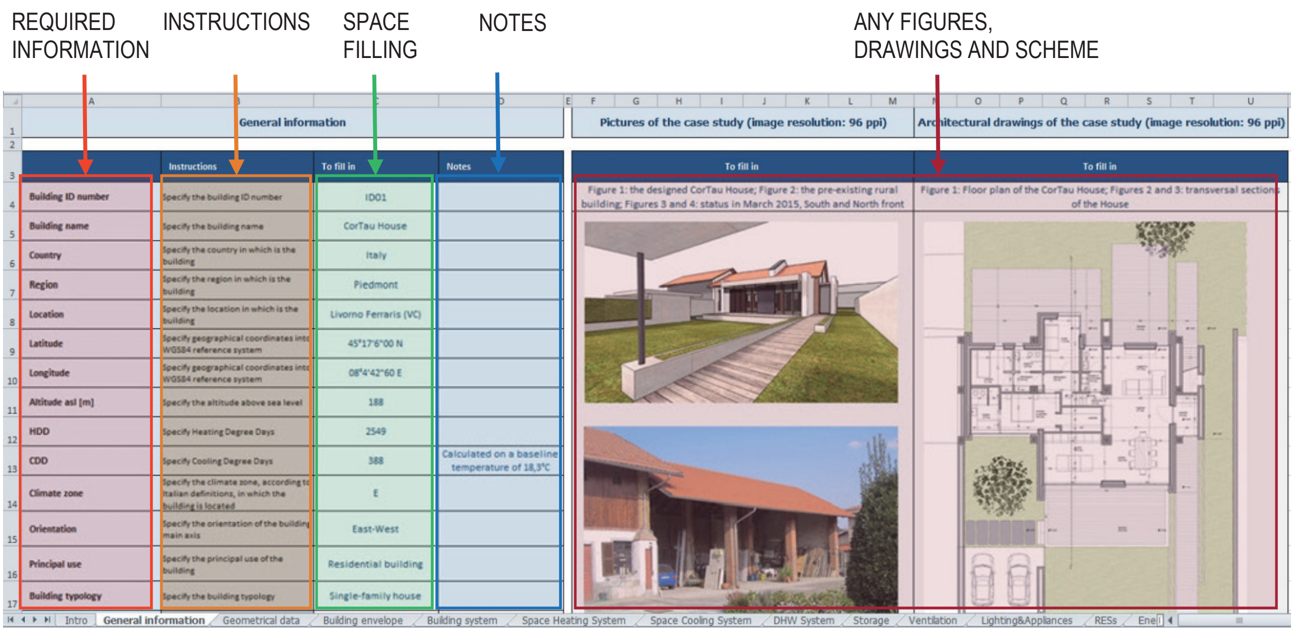


**Figure 1.** A screenshot of the database, section "General information".

In some specific sections, there are other columns dedicated to figures, drawings and schemes inclusion. Some of these data have to be filled, while others can be selected from drop-down menu.

In each section specific data about the analyzed case study are required; the first and the second sections are intended to provide an overview about the building. The first one collects general information concerning location, climate zone, period of construction, building typology and principal use of the building and whether it is a new construction or the result of a retrofit intervention on an existing building. Moreover, in this first section it is possible to indicate if the building is monitored and to specify operational parameters; pictures and architecture drawings of the case study are also required. The second section, containing geometrical data of the building (e.g. number of floors, floor surfaces and volumes), completes the introductory overview of the building.

The third spreadsheet contains data about opaque and transparent building envelope. For each kind of opaque building enclosure towards external and unheated spaces thermal transmittance, periodic thermal transmittance and surface mass are required; moreover, material layers should be described by indicating, if possible, thickness and features of each material. Each different kind of window should be also specified, by indicating thermal transmittance values and features of the glasses and frame. Moreover, information about solar shadings and thermal bridges are required.

Subsequently, sections from 4 to 11 are focused on the building systems. Specifically, the fourth section consists of a brief overview of the HVAC system configuration, including the presence of renewable energy sources (RESs). The fifth and sixth sections - referring to the space heating and cooling system – require several and different data, through schedules of system operating hours, set-point temperature and relative humidity, and features related to generation, distribution, control system, and terminal devices, to primary air system configuration. The section about the domestic hot water (DHW) is similar to the last listed. A section for the possible presence of a storage, and its related data, follows; the use to which the storage is dedicated, its volume, temperature have to be indicated. Then in the following section technical data are required in order to define the main features as type of ventilation system, air flow rate, the possible presence of heat recovery and its efficiency. The tenth section concerns instead the lighting system; here the typology, the total power and the operational schedule of each lighting system of the building are specified. The last section dedicated to the building system deals with RESs. Particularly, one portion is referred to the specification of the photovoltaic system, if existing; information about the technology, the panels' location and orientation, the dimensions and the system power, are requested. Another part is related to the features of the solar thermal system, if present; specific data about this system have to be filled, as technology type, panels location, orientation and dimensions, maximum temperature. Then, if other RESs are installed, there is the possibility to specify them.

After characterizing the envelope and systems, the database moves to focus on the case study energy data. The required information consist of energy needs and uses, delivered energy, RESs production, primary energy consumptions, $CO_2$ emissions and energy performance indexes (**Table 2**). Specifically, two sections, characterized by the same structure, are dedicated to energy performances; the former refers to calculated data, while the latter to monitored data. Regarding energy needs, the space heating and cooling energy need, and the electricity for lighting and appliances have to be specified, including the methodology used for the calculation in the case of presence of calculated data. With respect to energy uses, different end uses are reported: space heating and space cooling, DHW production, ventilation, auxiliary, lighting, appliances and others (if present). For each end use, it is necessary to specify the related energy carrier. Consequently, the total energy consumption for each energy carrier is automatically generated. Afterward there is a summary of the energy delivered to the building subdivided for the different energy carrier. The following part of the section refers to renewable energies. Precisely, five subdivisions are of interest to renewable energy produced on-site; percentage of renewable energy produced with heat pump; renewable energy consumed on-site; exported energy; renewable energy dissipation. Then, there is a part for the primary energy (delivered, produced from RESs on-site, produced from RESs and consumed on-site, exported, percentage of RESs contribution) and for $CO_2$ emissions, calculated with both national and European factors, which have to be specified in the fourteenth section called "Conversion factors". The last sub-section "Energy class and indexes" requires indexes for space heating and cooling, DHW production, and global energy performance, evaluated according to national certification; it is necessary also to specify the used methodology/software.

The fifteenth section is related to the economic valuation; it is required to specify the total investment cost for building realization, and separately the investment costs for the envelope, systems and other works, as for example excavation, foundations, etc. Furthermore, running costs are required in terms of energy, maintenance and replacement costs, after and before the renovation in the case of retrofit interventions. It is necessary to indicate if the investor benefits from incentives and tax credits. The last part presents some economic indexes as the payback period, the net present value (NPV) and the profitability index (PI).

The sixteenth section refers to sustainable and green features. It is made of eight subsections that focus on sustainability issues related to the examined case study. From the environmental quality of the site, through bioclimatic design elements, the use of natural materials, the water and waste management, the carbon reduction strategies, to the green transportation, this section deals with aspects - not emerging from the other sections – that underline the sustainability level of the building.

At the end, the last section is dedicated to bibliographic and web references related to the analyzed case study.

## Conclusions and future developments

The main goal of the database is to provide as complete and detailed as possible an overview of the presence of high efficient buildings in different Mediterranean countries. The database aims to cover the variety of building typologies and features characterizing the European building stock and is, indeed, designed to be modified and implemented in future. The availability of a large number of comparable data from different case studies would surely help to draw on the lessons learnt from good practices in Mediterranean climate. Up to this moment, the database was tested on three Italian case studies (two of these described in subsequent papers) and on two Mediterranean ones. In order to serve as a guide for investors, designers and policy makers, it is necessary to collect inside the specified database as many as possible of the buildings in question. In a process oriented to a large-scale diffusion of nZEBs on the market, the main function of this tool is to collect and share quantitative and detailed data referred to good practices of energy efficient buildings in order to compare and assess the most important information on the available solutions, on the results obtained in terms of energy and monetary savings, and also on local market and legislation conditions. ■

**Table 2.** Sub-sections for the energy data.

| | |
|---|---|
| A | Energy needs |
| B | Energy uses |
| C | Energy delivered-to-building |
| D | Renewable energy |
| E | Primary energy |
| F | $CO_2$ emissions |
| G | National energy class |