LSI LASTEM
Environmental Monitoring Solutions

SMART CITIES
Monitoring systems

Monitoring systems for:

- **Interventions on building envelopes**
- **Interventions on urban planning and urban design elements**
- **Interventions on population health in relation to heat stress**
- **Interventions for indoor environmental comfort and energy savings in buildings**

There is an increasing need to regenerate, redevelop and design urban contexts capable of proactively adapting to chronic and acute stresses due to ongoing climate change.

A correct choice of design measures passes through the use of simulation models, correct input data and field assessments before and after interventions. The areas where LSI LASTEM instrumentation can help in measuring and monitoring the results of the choices, made to mitigate the phenomena in progress, are mainly addressed to the following types of renovation and specific designs:

1. Mitigation of thermal overheating of buildings through interventions on facades and roofs.
2. Mitigation of overheating in cities by development of green spaces, interventions on the materials used for roads, car parks, pavements, walkways, on the choices of building characteristics and on the building plan. Also taking into account the mitigation of the concentration of pollutants by means of wind-dilution processes, intervening on the shape and orientation relationships of buildings, streets and green spaces.
3. Evaluation of the effect of heat also in view of heat waves through the measurement of microclimatic indices of thermal stress and comfort, in order to prevent health risks to population.
4. Increasing healthiness and environmental comfort inside buildings in relation to technical interventions on the building envelope, architectural and green solutions defined also with the aim of increasing energy savings.

Interventions on building envelopes

Green facades and roofs

Renovating or designing facades and roofs of buildings, through solutions capable of shielding them by means of green structures (vegetation), brings the following benefits:

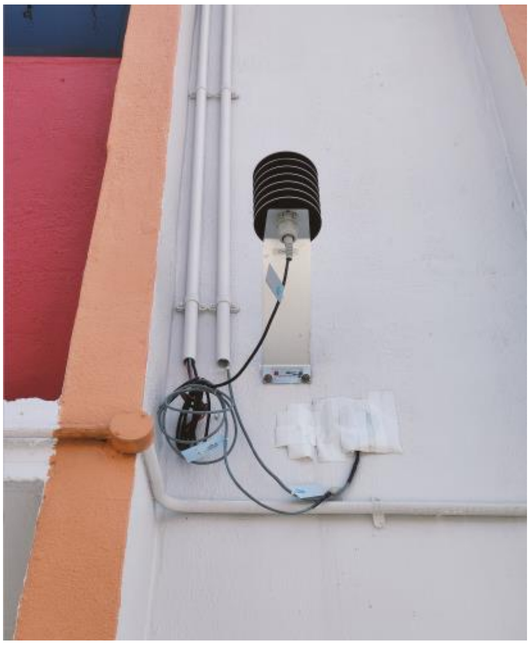
- Reduced air temperature and radiant temperature inside the building and thus increased thermal comfort, allowing the use of air conditioning system to be reduced.
- Increased insulation of the building. The structure protects the building from summer heating or winter cooling of the walls. Depending on the case, this reduces the heat flow entering or leaving the structures, thus increasing the insulating power of the walls and roof in order to reduce the use of air conditioning and heating equipment.
- Reduction of heat re-emitted from the building with reduction of the urban heat island effect.
- Reduction of the air temperature above the roofs with a consequent increase in the efficiency of the air conditioning system, which draw-in less overheated air before entering into the system.
- Increased absorption of rainwater. Green roofs, if properly drained, can absorb rainwater, reducing the risk of flooding.
- Increased CO_2 absorption through the photosynthesis of plants.
- Reduction of noise inside the building due to the sound-insulating characteristics of the vegetation.
- Possibility of zero-mile vegetable production.
- General increase in healthiness and beautification of the urban environment.

Reflective facades and roofs (heat-reflecting paints), window films

Renovating or designing the facades, flat roofs and windows of buildings by applying thermo-reflective materials or paints that reflect the solar radiation incident on them. With a low solar absorption value and a high emissivity value, these materials ensure that the surfaces hit by the sun do not overheat and therefore lose heat through radiation.
This technique has the following advantages:

- Increased passive cooling, with a reduction in the surface temperature of the roof and facades and a consequent reduction in the air and radiant temperature inside the building. Increased thermal comfort is achieved by reducing the use of air conditioning.
- Reduction of the air temperature above the roofs resulting in an increase in the efficiency of air conditioning system, which draw-in less overheated air before entering into the system.
- In the presence of a photovoltaic system on the roof, an increase in its efficiency due to the lower air temperature and, in the case of bi-facial panels, more reflected radiation incident on the lower face of the panel.
- Decreased radiant temperature inside the building when films are applied to the glass surfaces, increased thermal comfort and reduced use of air conditioning systems.

Ventilated facades



A ventilated facade bases its operation on the movement of air that is conveyed within the space between the facade and the cladding. This is a natural convective motion, which depends on the temperature difference between the inside and outside of the cavity.
Among the possible technological solutions, the ventilated facade offers many advantages in terms of energy saving, sound insulation, protection of the structure, but also architectural value.
During summer, the rise in air temperature in the cavity causes the chimney effect, which triggers an upward air movement. In this way, heat is drawn away, reducing the temperature on the inner wall. During winter, on the other hand, the cavity keeps the internal wall temperature in balance, reducing problems related to humidity and surface condensation.
The ventilated facade insulates the structure from the acoustic impact of the outside and protects it from the effect of weather, ensuring better preservation of the structure.

Interventions on urban planning and urban design elements

Urban planning to increase the climate resilience of cities is increasingly important. When designing or 'restyling' cities, the orientation, shape and size of buildings and streets, the type of surface materials (walls, roads, car parks, pavements, cycle paths), the size, presence and position of green areas, the presence of shaded areas, and the increased absorption of rainwater, are all elements that help to improve the healthiness of the city and liveability of outdoor spaces. Better urban planning has the following results:

- Decreased absorption of incident solar radiation, resulting in decreased heat flux from convection and thus decreased air temperature for heat mitigation and increased thermal comfort.
- Increased absorption of rainwater, which, if channelled into tanks, can also be reused to water gardens or to be sprayed, when necessary, on pavements to decrease surface temperature.
- Reduction of pollutants through increased wind circulation to improve air recirculation/dilution (gases and dust) and reduction of hazardous photochemical reactions.

Interventions on population health in relation to heat stress

During extreme heat waves that hit cities, it is necessary to intervene by limiting the exposure of the most fragile individuals and categories of workers who, due to their activities, have to work outdoors, sometimes even wearing personal protective equipment that potentially increases the risks of heat stroke. Monitoring heat stress through the use of heat stress indices has the following advantages:

- Microclimate indices assess a combination of environmental quantities (air and radiant temperature, relative humidity and air velocity) and the characteristics of individuals (metabolic load and clothing) and are therefore more suitable than temperature assessment alone for quantifying thermal sensation and related risks.
- Warn the fragile population by advising them to reduce outdoor exposure.
- Advise employers of personnel working outdoors to reschedule working time and exposure.
- Advise people to frequent less hot areas of the city during their leisure time.
- Evaluate the degree of heat after interventions, carried out to mitigate city heat stress.
- Assess the degree of heat at statistical and historical ends.

Interventions for indoor environmental comfort and energy savings in buildings

An efficient building is able to maintain proper living comfort while saving as much energy as possible. This efficiency is achieved through a series of interventions on the building envelope and surfaces, the supply of natural light, air exchange and filtration. The evaluation of the microclimate inside buildings serves to quantify comfort, compared to an optimal value, in order to:

- Provide a 'target' air temperature value for the regulation of the air conditioning and heating systems. This value considers a mix of environmental quantities and parameters relating to the person, such as the type of clothing worn and the metabolic load.
- Provide an objective (comparable) assessment that considers the set of variables affecting thermal sensation: air temperature, radiant temperature, relative humidity, air speed.
- Provide an assessment that includes thermal gradients and air movements.
- Provide an assessment that includes air changes for the purpose of air quality but also in consideration of draughts, which can be harmful to health if too high.
- Provide an assessment on lighting comfort.
- Provide an assessment on the degree of sound emitted by the technical systems in the building.

Monitoring systems for interventions on building envelopes

- Multi-point and multi-parameter system for measuring a range of quantities on the roof, along the facade (exterior and cavity where present) and inside the building
- Sensors are connected to multi-input modules which in turn are connected via cable (RS485 bus) to the master unit
- Sensors inside the building (temperature +RH%, surface temperature, black globe temperature) can be connected via radio, to a multi-input module
- Master unit for local and/or remote data acquisition, storage and communication
- Extremely flexible system that can be configured according to requirements

1.1 Green facades and roofs

In this application, measurement instrumentation is typically required in two stages. In pilot projects, during the research phase of adoptable solutions, the monitoring of environmental parameters is necessary to understand the suitable type of vegetation and how efficient the defined solutions are in relation to the objective. In these phases, it is necessary to monitor: the climate as a whole, the conditions adjacent to the vegetation, the water content and temperature of the soil, the thermo-hygrometric situation and ventilation in the space between the building and the vegetation layer support, as well as the microclimate inside the building, in order to understand the results obtained in relation to the choices made. In the installed systems, once the project is operational, to monitor the water and climate conditions of facades and roofs to carefully modulate the water requirements of the vegetation and be able to understand and solve any contingent problems.

1.2 Reflective facades and roofs (heat-reflecting paints), window films

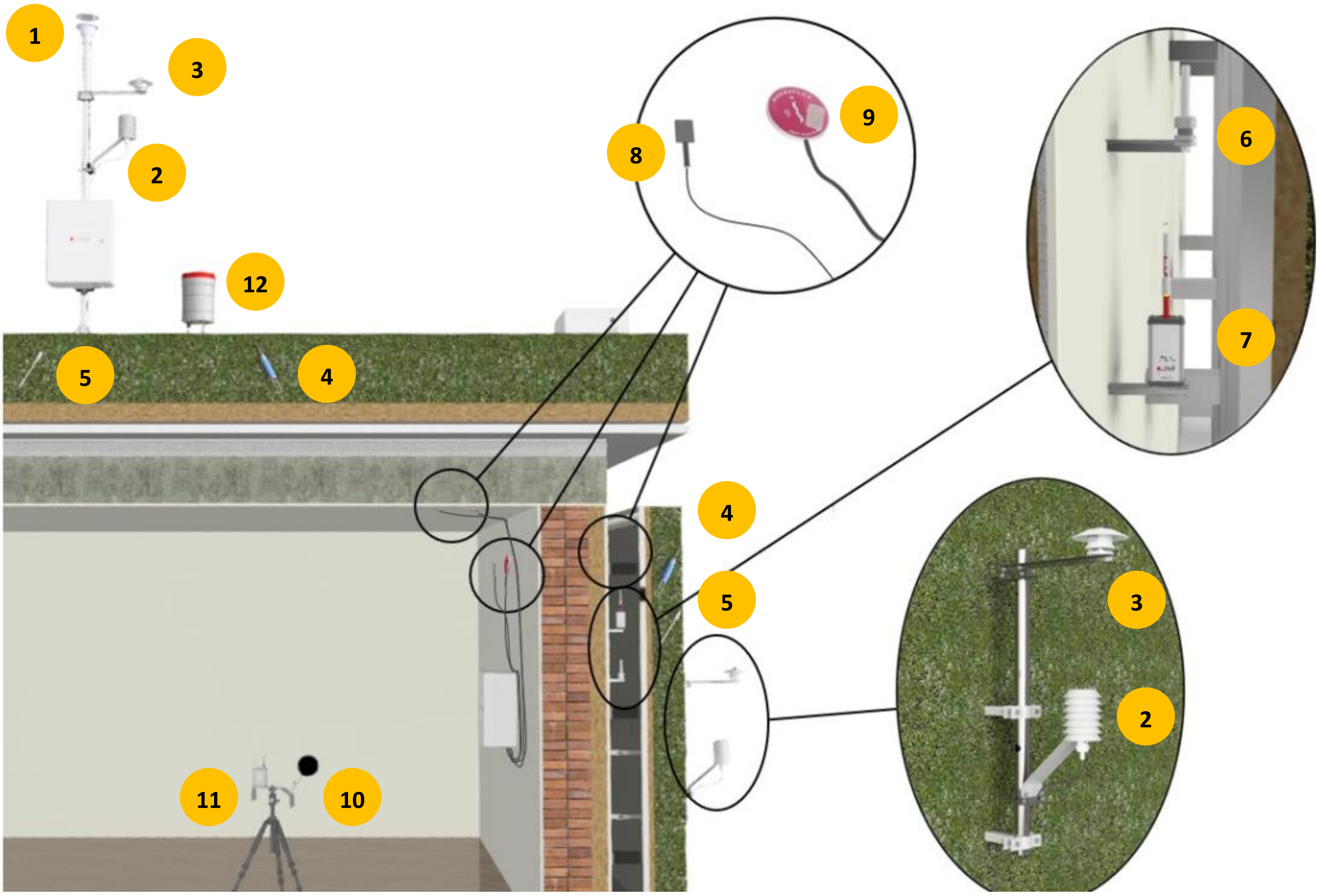
As these thermo-reflective paints are usually applied to existing buildings, the instrumentation is used to understand the improvements before/after application. In special cases, differences are assessed simultaneously on two buildings or different facades/parts of the same building (one painted, the other not) with the same structural characteristics and similar orientation. Since the intervention is based on modifying the thermal absorption of the facades and roof, an important parameter is the net radiation on the surfaces and the heat flow through them, as well as the surface temperature of the roof and facades (inside and outside). Wind must also be analysed, depending on its ability to remove heat from structures. It is also necessary to assess the microclimate inside the building to understand how it actually changes as a function of the choices made.

1.3 Ventilated facades

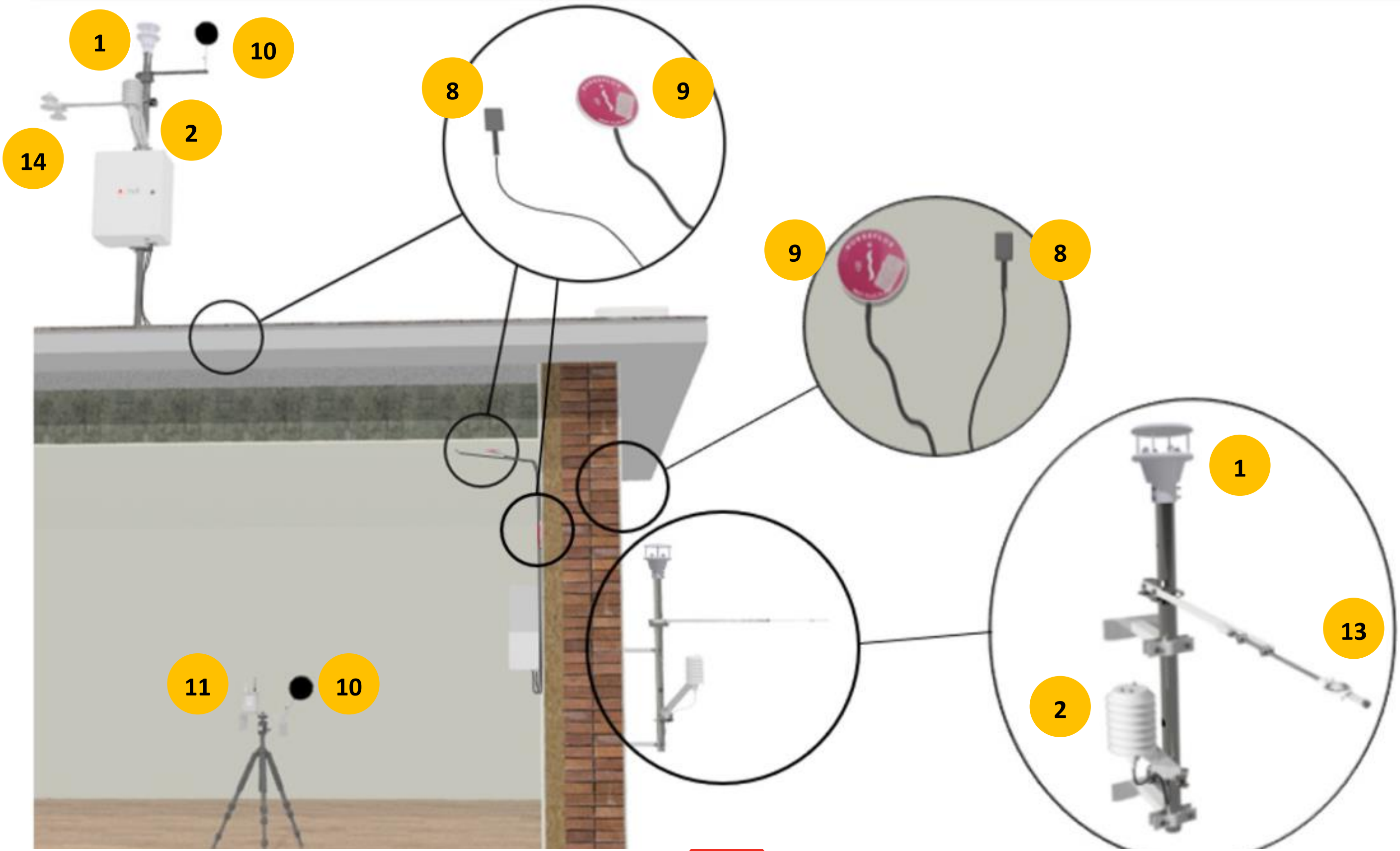
The effectiveness of the ventilated facade solution is highly dependent on the micro-environmental conditions within the cavity. The temperature, humidity and air velocity parameters inside the cavity will change the element's ability to remove heat and stabilise the thermal condition. An analysis of the cavity parameters allows the effectiveness of the intervention to be assessed. In addition, monitoring the thermal flow of the wall and the temperature and humidity conditions inside the building allows the effect of the intervention on the living unit to be assessed from the point of view of thermal well-being.

Monitoring systems for interventions on building envelopes

1.1 Green facades and roof

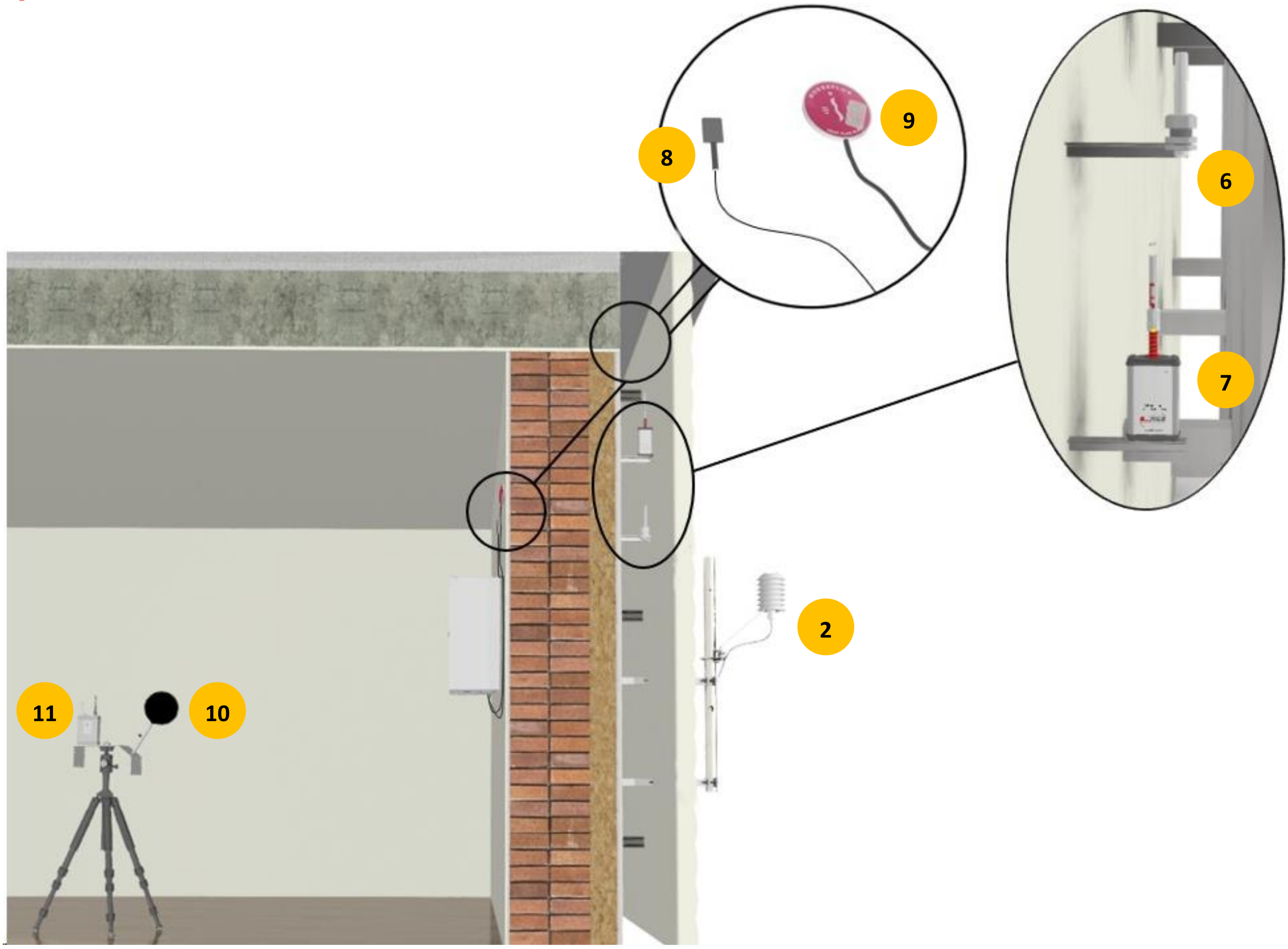


1.2 Reflective facades and roofs (heat-reflecting paints), window films



Monitoring systems for interventions on building envelopes

1.3 Ventilated facades



The sensors used for monitoring, shown in the diagrams on Page 7 and 8, are detailed in the Table on Page 9 and 10 and are listed in the respective kits described in the columns:

- 1.1 Green facades and roofs
- 1.2 Painted facades and roofs
- 1.3 Ventilated facades

Installation layout

Multi-point system with sensors installed on the roof, along the facade and inside the building. Each sensor is connected to an interface module, all interface modules are connected on an RS485 bus (or via radio) to a Master acquisition unit, for data storage and communication. Below are the sensors that make up the systems:

PN	Picture	Quantity	Kit		
			1.1 Green facades and roof	1.2 Painted facades and roof	1.3 Ventila-ted facades
DNB306		Wind velocity Wind direction	Roof 1	Roof + Facade 1	
DMA672.1 + DYA230		Air temperature Air RH% with anti-radiant shield	Roof + Facade 2	Roof + Facade 2	Facade 2
DPA154		Global radiation	Roof + Facade 3		
DQA340		Soil temperature Soil water content	Roof + Facade 4		
DLE041A		Soil temperature	Roof + Facade 5		
DMA672.5		Air temperature Air RH%	Cavity 6		Cavity 6
ESV107.1		Air velocity	Cavity 7		Cavity 7

PN	Picture	Quantity	Kit		
			1.1 Green facades and roof	**1.2 Painted facades and roof**	**1.3 Ventila-ted facades**
DLE124A		Surface temperature	Facade + Internal wall + Ceiling **8**	Roof + Internal wall + Ceiling **8**	Cavity + Internal wall **8**
DPA240		Thermal flux	Internal wall + Ceiling **9**	Internal wall + Ceiling **9**	Cavity + Ceiling **9**
DMA131A		Black globe temperature	Indoor **10**	Indoor **10**	Indoor **10**
EXP811.*		Air temperature Air RH% In addition: **Option 1** (EXP811.1): N.2 surface temperature **Option 2** (EXP811.2): N.1 surface temperature N.1 black globe temperature	Indoor **11**	Indoor **11**	Indoor **11**
DQA230		Rainfall	Roof **12**		
PRRDA0100A		Net radiation (alternative to DPA266)		Facade **13**	
DPA266		4 component net radiation: • N.2 pyranometers (flat spectrum) for global and reflected radiation (short bandwidth) • N.2 pirgeometers for incoming and outgoing radiation (long bandwidth)		Roof **14**	

System installed on the roof (only 1.1 and 1.2)

Ref. Fig.	PN	Description	Kit	Qty	Notes
		Data acquisition system	1.1,1.2	1	
	DLALB0100	Alpha-Log/7GB/n.2 RS232/n.1 RS485/n.2 USB/n.1 Ethernet			
	MDMMB1110.1	ALIEM/Inputs extension/N.8 Analog.+4 Digitals/RS485-Modbus			
	ELF340	Box IP66/50x40x16cm/230V->13,8V/50W/batt.2Ah			
	EDTUA2130	Input board-Bus RS485/N.3 inputs RS485/IP68			Necessary with bus RS485
	DYA074	Arm/ELFxxx/to D=45÷65mm.pole			
		Remote communication system (also Wi-Fi)	1.1, 1.2	1	
	TXCRA2200	4G LTE cat. 4 Global router, Wi-Fi, 1 Ethernet port, antennas, power 9...30 Vdc, DIN rail mount			
	TXANA3033	Antenna SMA COMBO MIMO mobile / GNSS / WIFI ROOF	Optional		
	DEA611	External antenna 2DB/5 m cable/support			
		Sensors			
1		**Wind speed and direction**	1.1, 1.2	1	
	DNB306	Sensor/Sonic/WS+WD/2x4÷20 mA/10÷30V			
	DWA831	Cable/L=5m/DNB20x-30x			
2		**Air temperature and RH%**	1.1, 1.2	1	
	DMA672.1	Sensor/T+RH%/Pt100+0÷1V/12V/Cable L.3m			
	DYA230	Radiant screen/NV/DMA67x-033			
	DYA049	Collar/for sensor arm to D=45÷65mm pole			
3		**Global solar radiation**	1.1	1	
	DPA154	Sensor/Pyranometer/First Class/µV			
	DWA605A	Cable DIN47100 L=5 m/sensor DPA154			
	DYA034	Support/DPA154-855-863-873-252-952-817-822-980/Oriz./a DYA049/L=440mm			
	DYA049	Collar/for sensor arm to D=45÷65mm pole			
10		**Radiant temperature**	1.2	1	
	DMA131A	Sensor/Temp.TG/IP65/Cable STD DIN47100 L=5 m			
	DYA032	Arm/DPA053-008, ESR003, DQA601, DMA131/ to DYA049			
	DYA049	Collar/for sensor arm to D=45÷65mm pole			
12		**Rainfall**	1.1	1	
	DQA230.1	Sensor/Rain gauge/324cmq/Siphone/Hz			
	DWA505A	Cable STD/L=5m/sensor			
	DYA039.1	Base/DQA23x/soil			
4		**Soil temperature and water content**	1.1	1	
	DQA340	Sensor/Material % water content+Temp./DTR/2x0÷1V/6÷24V			
5		**Soil temperature**	1.1	1	Altern. to DQA340
	DLE041A	Sensor/Penetration Temp/Pt100/Cable STD L.10m			
8		**Surface temperature**	1.2	1	
	DLE124A	Sensor/Surface Temp/Pt100/Cable STD L.20 m			
9		**Thermal flux**	1.2	1	
	DPE240A.1	Sensor/Thermal flowmeter/µV/Cable L=15 m			
		Mast H.2 m	1.1, 1.2	1	
	DYA006.1	Pole/H=2m/D=50mm			
	DYA021	Tripod/soil installation/pole D=50 mm			

Ref. Fig.	PN	Description	Kit	Qty	Notes
14		**4-component net solar radiation**	1.2	1	
	DPA266	4-component-net radiometer/cable L=5 m			
	MAPSA2000	Arm/DPA266/pole 40...65mm			
13		**Net solar radiation**	1.2	1	Altern. to DPA266
	PRRDA0100A	Thermopile net radiometer, direct output with cable STD DIN47100			
	DYA031	Arm/DPA240/to DYA049			
	DYA049	Collar/for sensor arm to D=45÷65mm pole			

System installed on the facade

Ref. Fig.	PN	Description	Kit	Qty	Notes
		Multi-input module	All	1	
	MDMMB1110.1	ALIEM/Inputs extension/N.8 Analog.+4 Digitals/RS485-Modbus			
	ELF340	Box IP66/50x40x16cm/230V->13,8V/50W/batt.2Ah			
	EDTUA2130	Input board-Bus RS485/N.3 inputs RS485/IP68			Necessary with bus RS485
		Sensors			
2		**Air temperature and RH%**	All		
	DMA672.5	Sensor/T+RH%/Pt100+0÷1V/12V/Cable L. 3m+con.DWA9nn			
	DWA910	Cable/L=10m/DMA672.5			
	DYA230	Radiant screen/NV/DMA67x-033			
	DYA049	Collar/for sensor arm to D=45÷65mm pole			
3		**Solar radiation**	1.1	1	
	DPA154	Sensor/Pyranometer/First Class/µV			
	DWA605A	Cable DIN47100 L=5 m/sensor DPA154			
	DYA034	Support/DPA154-855-863-873-252-952-817-822-980/Oriz./a DYA049/L=440mm			
	DYA049	Collar/for sensor arm to D=45÷65mm pole			
4		**Soil temperature and water content**	1.1	1	
	DQA340	Sensor/Material % water content+Temp./DTR/2x0÷1V/6÷24V			
5		**Soil temperature**	1.1	1	Altern. a DQA340
	DLE041A	Sensor/Material % water content+Temp./DTR/2x0÷1V/6÷24V			
1		**Wind speed and direction**	1.2	1	
	DNB306	Sensor/Sonic/WS+WD/2x4÷20 mA/10÷30V			
	DWA831	Cable/L=5m/DNB20x-30x			
13		**Net radiation**	1.2	1	
	PRRDA0100A	Thermopile net radiometer, direct output with cable STD DIN47100			
	DYA031	Arm/PRRDA0100A/to DYA049			
	DYA049	Collar/for sensor arm to D=45÷65mm pole			
8		**Surface temperature**	1.2	1	
	DLE124A	Sensor/Surface Temp/Pt100/Cable STD L.20 m			
9		**Thermal flux**	1.2	1	
	DPE240A.1	Sensor/Thermal flowmeter/µV/Cable L=15 m			

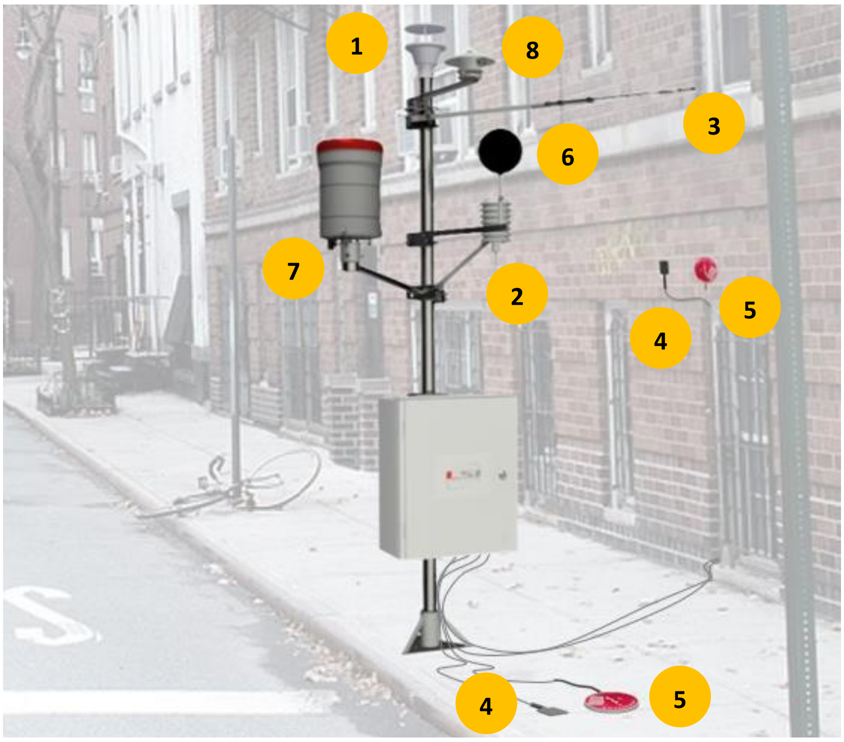
System installed in the cavity (only 1.1 and 1.3)

Ref. Fig.	PN	Description	Kit	Qty	Notes
		Sensors			
6		**Air temperature and RH%**	1.1, 1.3	1	
	DMA672.5	Sensor/T+RH%/Pt100+0÷1V/12V/Cable L. 3m+con.DWA9nn			
	DWA910	Cable/L=10m/DMA672.5			
8		**Surface temperature**	1.1, 1.3	1	
	DLE124A	Sensor/Surface Temp/Pt100/Cable STD L.20 m			
		Wind speed	1.1, 1.3	1	
7	**ESV107.1**	Sensor/Wind speed/hot wire/mV/Cable 10 m			

System installed indoor (all)

Ref. Fig.	PN	Description	Kit	Qty	Notes
		Multi-input module	All	1	
	MDMMB1110.1	ALIEM/Inputs extension/N.8 Analog.+4 Digitals/RS485-Modbus			
	ELF340	Box IP66/50x40x16cm/230V->13,8V/50W/batt.2Ah			
	EDTUA2130	Input board-Bus RS485/N.3 inputs RS485/IP68			Necessary with bus RS485
		Radio receiver	All	1	For sensor EXP8311.1
	EXP301	Receiver EXP sensors radio signals/12V			
	DWA601A	Cable/L=10m/EXP301-401-402			
		Sensors			
8		**Surface temperature**	All	2	
	DLE124A	Sensor/Surface Temp/Pt100/Cable STD L.20 m			
9		**Thermal flux**	All	2	
	DPE240A.1	Sensor/Thermal flowmeter/µV/Cable L=15 m			
11		**Radiant temperature**	All	1	
	DMA131A	Sensor/TG Temp/IP65/Cable STD DIN47100 L=5 m			
10		**Air temperatura and RH% radio sensor**	All	1	
	EXP811.1	Sensor/Temp.+RH%/N.2 Pt100/869 MHz/Battery			

Meteorological station for interventions on urban planning and urban design elements



- Compact and energy autonomous measuring station (if equipped with solar panel)
- Communication to remote database via wireless router
- Pole-mounted sensors fixed above horizontal and vertical surfaces

The meteorological station is useful, in the study phase, to acquire a series of quantities necessary for the simulation models that evaluate how potential urban intervention will achieve more resilient contexts capable of withstanding chronic and acute stresses due to ongoing climate change. Usually, as input to simulation models, data from databases are not sufficiently spatially resolved and thus not representative of the specific point of the urban microclimate, and moreover are often missing some important parameters. To enable a better simulation and thus a surpassing result, it is better to be able to use data acquired specifically in the context under observation, complete with parameters such as radiant temperature, surface temperatures, convection and radiation heat fluxes. In addition, the weather station can, when the work is completed, help to evaluate the results actually obtained after the intervention.

Layout di installazione

PN	Picture	Quantity	Installation
DNB306		Wind velocity Wind direction	Mast 1
DMA672.1 + DYA230		Air temperature Air RH% with anti-radiant shield	Mast 2
PRRDA0100A		Net radiation	Mast 3
DLE124A		Surface temperature	Horizontal and vertical surfaces 4
DPA240		Thermal flux	Horizontal and vertical surfaces 5
DMA131A		Black globe temperature	Mast 6
DQA230.1		Rainfall	Mast 7
DPA154		Global radiation	Mast 8

Selling kit

Ref. Fig.	PN	Description	Qty	Notes
		Data acquisition system	1	
	DLALB0100	Alpha-Log/400MB/n.2 RS232/n.1 RS485/n.2 USB/n.1 Ethernet		
	MDMMB1110.1	ALIEM/Inputs extension/N.8 Analog.+4 Digitals/RS485-Modbus		
	ELF340	Box IP66/50x40x16cm/230V->13,8V/50W/batt.2Ah		
	DYA074	Arm/ELFxxx/to D=45÷65mm.pole		
		Remote communication system	1	
	TXCRA2200	4G LTE cat. 4 Global router, Wi-Fi, 1 Ethernet port, antennas, power 9... 30 Vdc, DIN rail mount		
	DEA611	External antenna 2DB/5 m cable/support		
		Solar panel	Optional	
	DYA101	Solar panel/60W/cable L=5m		
	DYA064	Arm/Solar panel/to D=45÷65mm pole		
		Sensors		
1		**Wind speed and direction**	1	
	DNB306	Sensor/Sonic/WS+WD/2x4÷20 mA/10÷30V		
	DWA831	Cable/L=5m/DNB20x-30x		
2		**Air temperatrure and RH%**	1	
	DMA672.1	Sensor/T+RH%/Pt100+0÷1V/12V/Cable L.3m		
	DYA230	Radiant screen/NV/DMA67x-033		
	DYA049	Collar/for sensor arm to D=45÷65mm pole		
8		**Global solar radiation**	1	
	DPA154	Sensor/Pyranometer/First Class/μV		
	DWA605A	Cable DIN47100 L=5 m/sensor DPA154		
	DYA034	Support/DPA154-855-863-873-252-952-817-822-980/Oriz./a DYA049/ L=440mm		
	DYA049	Collar/for sensor arm to D=45÷65mm pole		
3		**Net solar radiation**	1	
	PRRDA0100A	Thermopile net radiometer, direct output with cable STD DIN47100		
	DYA031	Arm/PRRDA0100A/to DYA049		
	DYA049	Collar/for sensor arm to D=45÷65mm pole		
4		**Surface temperature**	2	
	DLE124A	Sensor/Surface Temp/Pt100/Cable STD L.20 m		
5		**Thermal flux**	2	
	DPE240A.1	Sensor/Thermal flowmeter/μV/Cable L=15 m		
6		**Radiant temperature**	1	
	DMA131A	Sensor/Temp.TG/IP65/Cable STD DIN47100 L=5 m		
	DYA032	Arm/DPA053-008, ESR003, DQA601, DMA131/ to DYA049		
	DYA049	Collar/for sensor arm to D=45÷65mm pole		
7		**Rainfall amount**	1	
	DQA230.1	Sensor/Rain gauge/324cmq/Siphone/Hz		
	DWA505A	Cable STD/L=5m/sensor		
	DYA040.2	Arm/DQA230-231/to D=50mm.pole		
	DYA058	Lateral arm/D=50 mm.sensors/to D=45÷65mm. pole		
		Mast H.3 m	1	
	DYA010.1	Pole/H=3m/D=50mm		
	DYA021	Tripod/soil installation/pole D=50 mm		
	DYA023	Ground picket/L=0,6m/3set		

Meteorological station for interventions on population health in relation to heat stress

- System in accordance with ISO7243 and ISO7726
- Sensors for the calculation of WBGT, Humidex, Heat Indexes and UTCI (Universal Thermal Climate Index)
- Permanent or portable real-time system
- Designed to withstand harsh environments
- Real-time panel in the control centre via MQTT broker server
- SMS and alarm e-mail
- Electrical outputs for triggering devices for local alarms

Weather station equipped with sensors to acquire and calculate the main heat stress indices such as WBGT (ISO7243), Humidex, Heat Index and UTCI (Universal Thermal Climate Index), in order to:

- In typical work contexts, for real-time monitoring and warning related to the health and safety of workers in extreme outdoor heat stress conditions and to alert the safety manager on the need to reschedule or reduce subjects' exposure.
- In smart city contexts, to send data to remote servers from which the city's information system takes the information for further use.

The system consists of sensors, data logger and mounting accessories, for measuring air temperature, relative humidity, radiant temperature and wet temperature (other meteorological sensors are available). The data logger sends data to FTP and MQTT servers and produces alarms via SMS and e-mail, it also connects to local alarm devices and can sends data to SCADA systems via the Modbus RTU / TCP protocol.

(see Application Note MW9021-ITA-HeatStress page 8-11)

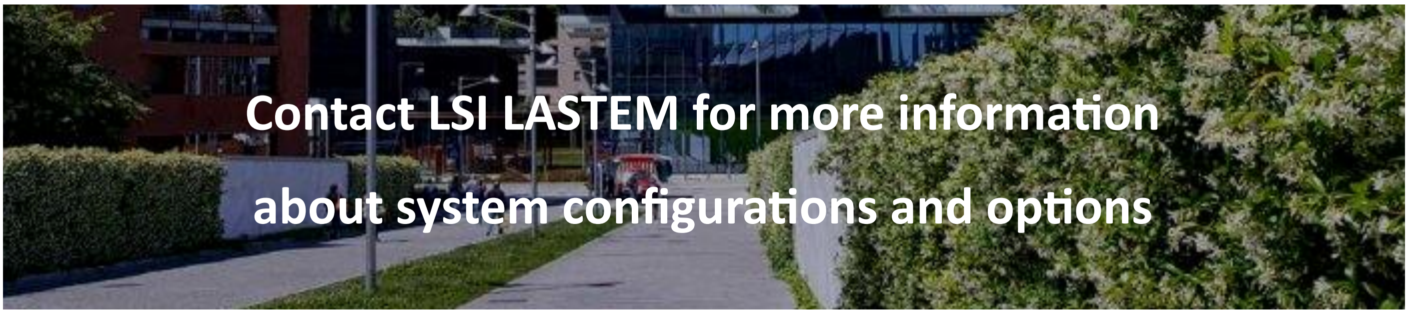
Portable system for indoor environmental comfort and energy savings in buildings

- A few minutes for the assembly of the control unit and start measuring
- Calculation of indices for moderate (PMV-PPD), hot (WBGT, PHS) and cold (IREQ) environments with PC programme
- Direct calculation, without the need for a PC programme, of WBGT and TO indices, draughts, floor temperature and radiant asymmetries
- Possibility of acquiring other quantities for Indoor Environmental Quality, such as air quality sensors and illuminance sensors to obtain an integrated system

Microclimatic station: the system consists of an instrument assembly (data logger and sensors) mounted on a tripod. Depending on the type of environment (moderate, hot and cold environments and localised discomfort), different types of sensors can be chosen. Some indices (WBGT, Operating Temperature and Localised Discomfort indices) are calculated directly by the data logger (M-Log), others are calculated in post-processing by means of the Gidas TEA (Thermal Environments Application) software on a PC, divided into three modules: Moderate, Hot and Cold Environments. **(see Application Note MW9020-ENG-Microclimate)**

- Sphensors: multi-parametric indoor radio sensors for IEQ
- Measurement quality at the highest market standards
- Real time data available on INDOOR CUBE cloud platform for analysis and monitoring projects

Sphensor are spherical multiparametric radio sensors that can be built up to form a network, they have been designed with a pleasant visual impact, to be harmoniously integrated into their surroundings. The sensors measure several physical and chemical quantities, sending data through a robust mesh radio network to the Sphensor Gateway to be finally transferred to the INDOOR CUBE platform. **(see Data sheet MW9001-ENG-14-Sphensor)**



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