AIRZONE

Solution for Villas

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SOLUTION FOR VILLAS - REGULATION OF AIR TO WATER HEAT PUMP + SINGLE-ZONE FCU + REVERSIBLE UNDER-FLOOR HEATING AND COOLING

The objective of this document is to show, through a case study, the different technical benefits that Airzone control solutions can offer to residential buildings with complex HVAC systems.

The triple service HVAC application will cover heating, cooling and domestic hot water (DHW) needs through an air to water heat pump system and single-zone fan coil units, combined with underfloor heating and cooling in each room.

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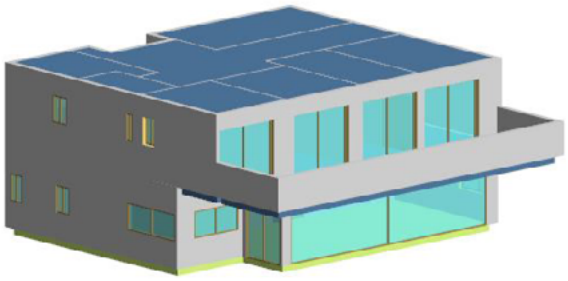
Description of the installation

The Airzone Projects Department has studied a luxury villa with the following characteristics:

- Location: Athens, Greece
- Use: Single-family Home
- Altitude: 3 meters

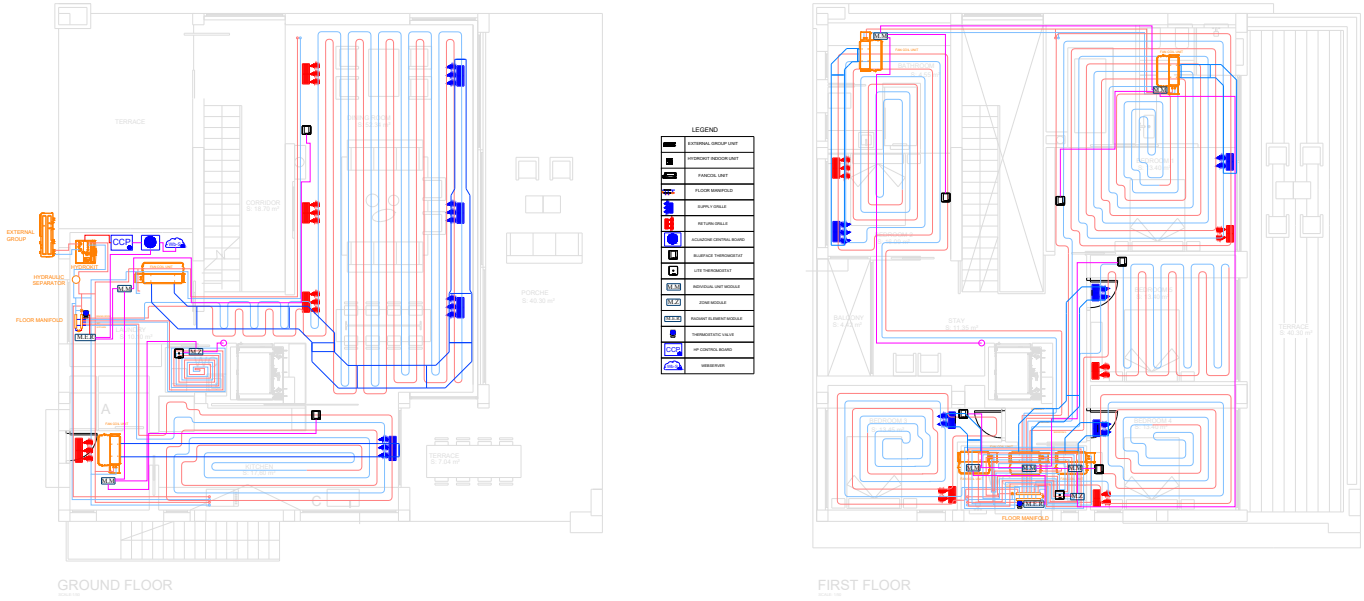
The villa has two floors with the following independent zones:

- **Ground floor:** living-dining room, kitchen, laundry, entrance hall and bathroom.
- **First floor:** 5 bedrooms and 3 bathrooms.



In order to carry out the energy study of the house, a 3D model was generated using the EnergyPlus calculation engine, which enables the calculation of thermal losses, thermal demand, comfort rate, etc., through simulations.

Installation plan



The layout of the villa is shown in the above plans, using individual fan coil units and an underfloor heating and cooling system with an air to water heat pump, secondary pumps and a dual set-point (cooling/heating) mixing valve.
These systems operate independently, creating significant problems in energy efficiency, thermal comfort and domestic hot water (DHW) management when both cooling and heating are needed simultaneously.

Disadvantages of the solution without Airzone:

- **Energy efficiency:** The lack of centralized integration can result in higher energy consumption due to the suboptimal operation of the systems.
- **Thermal comfort:** The inability to accurately and centrally adjust temperatures can lead to variations in comfort within the villa.
- **DHW management:** The simultaneous management of DHW and HVAC demand may not be optimal, without taking into account time schedules and use cycles, which affects both comfort and energy efficiency.
- **Complexity of the installation:** For the end user it can be difficult to manage the installation due to the number of devices, as it is necessary to manually use and coordinate several commands at the same time (heat pump, underfloor heating and cooling and fan coils).

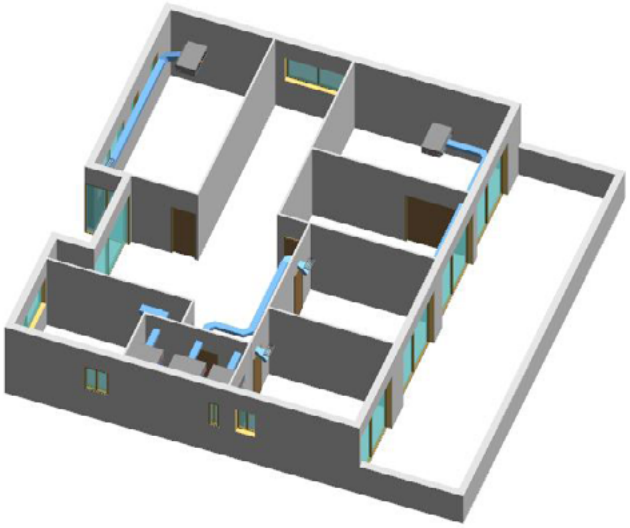
Solution for Villas

Solution proposed by Airzone

For this installation, Airzone presents a control solution that will meet user needs and that will be able to control both the single-zone fan coils and the underfloor heating and cooling, synchronizing them with the production system. Airzone proposes the Acuazone solution, which will control the entire installation, providing maximum energy efficiency and thermal comfort.

Acuazone is the most comprehensive solution for installation control. It adapts to all technologies: hydronic, mono/multisplit and VRV. It allows unified control from a single thermostat of the air conditioning and underfloor heating and cooling stages for each zone individually.

1. Airzone Acuazone system



System features

- Control of up to **32 zones** independently.
- Integrated control of units through **communication gateways**.
- **Eco-Adapt algorithm** to improve the energy efficiency of the installation:
  - -Efficient control of set-point temperature.
  - -Limitation of set-point temperatures.
  - -Control of radiant thermal inertia.
- **Input configurable** as auxiliary probe or remote on/off control of the system.
- **Configurable control output** for the activation of auxiliary boilers or controlled mechanical ventilation control (CMV). On/off relay output.
- All modules can be connected with both **wired and wireless thermostats**.
- **Underfloor heating and cooling** control.
- Display of machine **error codes** on the **Airzone thermostat** (check compatibility).
- **Compatible** with the **production control board** (AZX6CCPGAWI) and air to water PAC gateways.
- **Compatible** with **individual AC unit gateway modules**.

Characteristics by zone

- **Configuration of operation modes** (for 4-pipe configuration).
- **Immediate shutdown** by window contact or occupancy detection.
- Input for the imposition of **heat-only mode.**
- **A single thermostat per zone to** control the air conditioning and underfloor heating and cooling stages.

Solution proposed by Airzone

2. Components of the Acuazone system

ACUAZONE MAIN CONTROL BOARD – AZDI6ACUZONE

- Controls thermostat status (up to 32 zones).
- Controls the proportionality and minimum air supply of the dampers.
- Relay outputs for on/off control of the AC unit and boiler.
- Control gateway management.
- Communication with the installation's integrated control units.
- Communication with other external control systems through integration bus.

AIRZONE HYDRONIC PRODUCTION CONTROL BOARD – AZX6CCPGAWI

- Control of up to 32 systems.
- 7 control relays for cooling/heating mode, cold/hot air demand, cooling/heating radiant element.
- Inputs for semi-forced mode, boiler probe and DHW production.
- Configuration and control of zone parameters (room and set-point temperature, operation mode, etc.) and of systems using the Cloud platform.
- Time scheduling of temperature and operation mode.
- Remote firmware update and error management.
- Multi-user and multi-session.

AIRZONE-DAIKIN ALTHERMA 3 AIR TO WATER HP GATEWAY – AZX6GAWDA2

- Two-way communication of the basic control parameters (on/off control, set-point temperature, operation mode and fan speed) depending on the demand of the Airzone control system.
- Reading of controlled unit errors.
- Imposition of the water production temperature according to demand.

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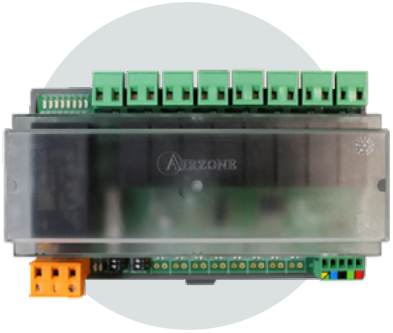
Solution proposed by Airzone

AIRZONE FANCOIL INDIVIDUAL UNIT ZONE MODULE WIRED – AZDI6ZMOFANC

- 2 relays to control the solenoid valves.
- 3 10 V outputs to control the speed of units of up to 3 speeds.
- 3 0-10 V outputs to control fan speed and the opening and closing of the cooling and heating solenoid valves.
- 3 digital inputs for open window detection, occupancy detection and Eco function.
- 3 analog probe inputs to measure room temperature and to measure the heating and cooling battery temperature.

AIRZONE ACUAZONE CONTROL MODULE OF RADIANT ELEMENTS – AZDI6OUTPUT8



- Control of up to 8 radiant elements via 10 A relays at 230 VAC.
- Module addressing via microswitches.
- Configuration of the heating/cooling/mixed modes via microswitches.

AIRZONE ACTUATOR ZONE MODULE WIRED – AZDI6MZZONC

- Open window detection input.
- Occupancy presence detection.
- Probe input.
- Remote probe function and distributed probe function.

Solution proposed by Airzone

AIRZONE BLUEFACE ZERO THERMOSTAT WIRED - AZDI6BLUEZEROCB

- Six languages available (French, Spanish, English, Italian, German and Portuguese).
- Temperature control, operation mode (main thermostat) and system fan speed.
- Display of room temperature and relative humidity in the zone.
- Eco-Adapt function.

AIRZONE ACUAZONE LITE THERMOSTAT WIRED - AZDI6LITECB

- Modification of the assigned set-point temperature in increments of 1°C to a maximum of ±3°C.
- Measurement of room temperature and relative humidity in the zone.
- Zone on/off.

Solution for Villas

Solution proposed by Airzone

WEBSERVER HUB AIRZONE CLOUD DUAL 2.4-5G/ETHERNET - AZX6WSPHUB

- Control of up to 32 systems.
- Configuration and control of zone parameters (room and set-point temperature, operation mode, etc.) and of systems using the Cloud platform.
- Access to the router via Bluetooth through the app.
- Multi-user and multi-session.
- Port for integration via the Modbus protocol.
- Integration via Local API.
- Remote update of Webserver firmware and connected systems.
- Remote management and solution of system errors.

AIRZONE BUS CABLE (2X0,5+2X0,22) 100 M - AZX6CABLEBUS100

Flexible shielded twisted cable. It is used to transmit data, analog and digital signal and also to supply Airzone elements. It is supplied in 100-meter cable reels.

- Use the Airzone cable to connect all system components. Please consult the safety information and the system installation manual.
- Safety information
- Installation manual

Solution proposed by Airzone

3. Bill of materials (BOM)

Full information on all the components necessary for Acuazone installation, specifying the corresponding units for this installation.

REFERENCE	MATERIAL	Units
AZDI6ACUAZONE	Airzone Acuazone main control board (DI6)	1
AZX6CCPGAWI	Airzone hydronic production control board	1
AZX6GAWDA2	Airzone-Daikin Altherma 3 air to water hp gateway	1
AZDI6BLUEZEROCB	Airzone Blueface Zero wired thermostat 32Z (DI6)	6
AZDI6LITECB	Airzone Lite wired thermostat 32Z (DI6)	2
AZDI6ZMOFANC	Fancoil individual unit zone module wired	7
AZDI6OUTPUT8	Airzone control module of radiant elements 32Z	2
AZDI6MZZONC	Airzone actuator zone module wired 32Z	2
AZX6WSPHUB	Webserver HUB Airzone Cloud Dual 2.4-5G/Ethernet	1
AZX6CABLEBUS100	Airzone bus wired (2x0.5+2x0.22) 100 m	1

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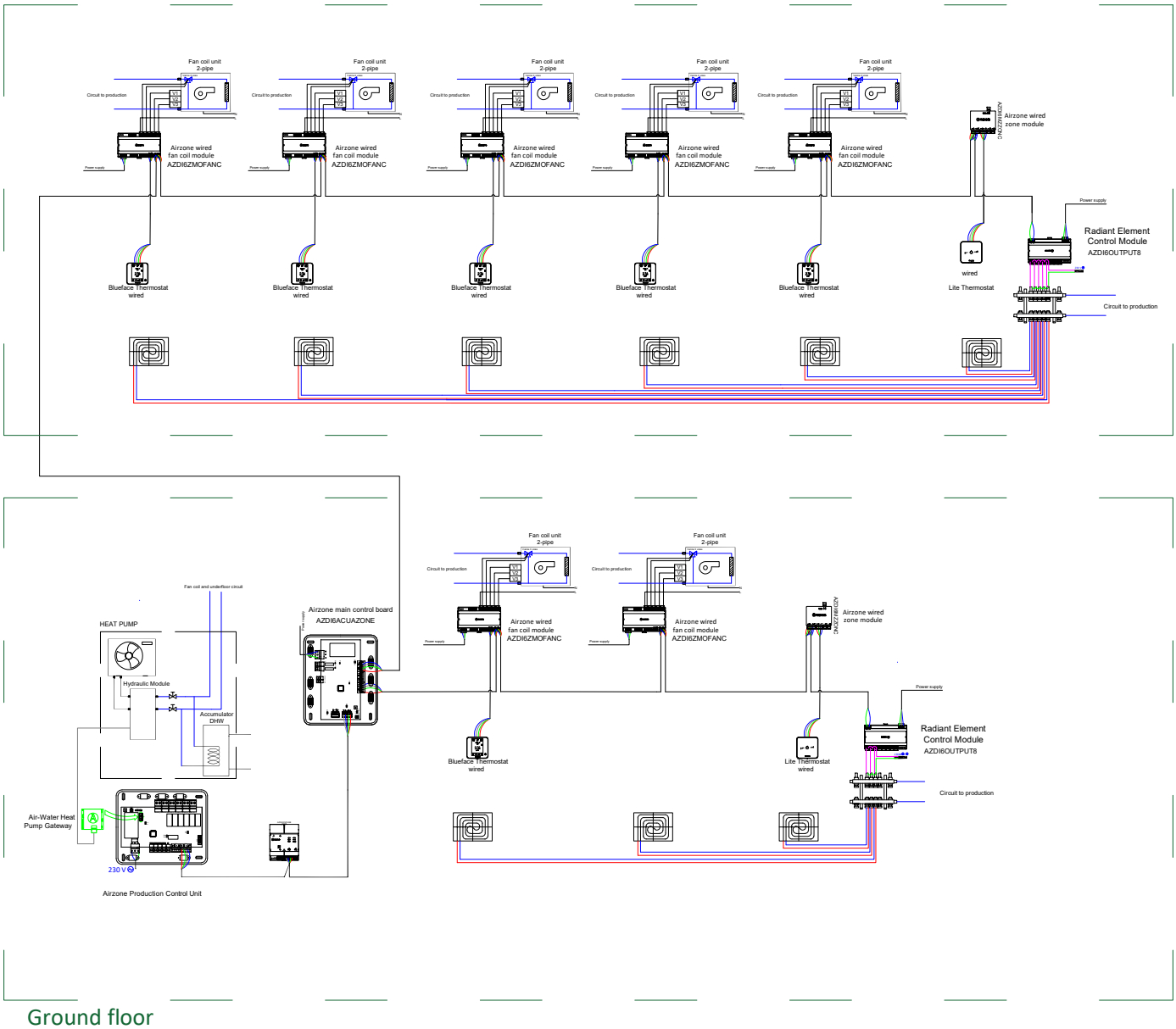
Solution proposed by Airzone

4. Airzone connection scheme

All the Acuazone system elements communicate with each other bi-directionally.

First floor



Ground floor

Connection scheme of individual fan coil units + underfloor heating and cooling:
https://doc.airzonecloud.com/Resources/CAD/CAD_HYD_AZDI6_Individual_fancoil_with_radiant_heating_cooling_up_to_32Z_Acuazone_IBPro32.pdf

Connection scheme of individual VRF + underfloor heating and cooling:
https://doc.airzonecloud.com/Resources/CAD/CAD_VRF_AZDI6_Individual_units_and_electric_heating_with_radiant_heating_cooling_up_to_32Z_Acuazone_IBPro32.pdf

Solution proposed by Airzone

5. Integration

- **Integration with home and building automation systems:**
  - Compatibility with the main BMS/home automation and IoT technologies.
  - Airzone Cloud app.
  - Amazon Alexa, Google Assistant and SmartThings voice assistants.
  - MODBUS RTU and possibility for MODBUS TCP/IP.
  - BACNET MSTP or TC/IP, Lutron and KNX integration gateways.
  - Drivers and plugins: Control4, Crestron, Nice, DeltaCore, IFTTT, Home Assistant, Shneider, Legrand, Hager.
  - Cloud API and REST API.

BMS AND HOME AUTOMATION STANDARD PROTOCOLS

alfredsmart · CHERUBINI · Control4 · CRESTRON · DELTA DORE · eedomus · energeasyconnect · ELAN · FERMAX · fhe · Home Assistant · EEDOM · legrand · LOXONE · LUTRON · Nice · RTI · SAVANT · Schneider Electric · SMART & CONNECTIVE · URC

STANDARD PROTOCOLS

BACnet · Modbus · KNX · zigbee · Z-WAVE

IOT

amazon alexa · works with the Google Assistant · Works with SmartThings · Works with IFTTT · ecobee · Honeywell · Nest

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Advantages of the proposed solution

Technical criteria

From a technical and control point of view, Acuazone provides added value to this installation.

- **Independent regulation.** Independently and specifically optimizes the thermal comfort conditions in each room thanks to a zoned management solution.
- **Single interface.** Manages all the units or systems available in each zone through a single interface, whether HVAC units, underfloor heating and cooling circuits or radiators.
- **Combined stage.** Consists of the joint management of the different units available in a room or zone. Allows a faster and more adequate response of the installation, resulting in improved thermal comfort and energy savings.
- **Total control.** Airzone communication gateways allow direct and two-way communication of Airzone systems with heat pumps (production) and indoor units via protocols certified by the main manufacturers.
- **Eco-Adapt.** Smart control algorithm for greater energy savings by adjusting set-point temperature ranges.
- **Thermal inertia.** Adapts the operation of the HVAC system to the thermal inertia of the construction elements thanks to our combined control algorithm.
- **Safety functions.** The anti-condensation, anti-freezing and anti-blocking functions protect and prolong the useful life of the installation.

Economic/energy criteria

The following table compares the annual consumption and expenditure of the installation before incorporating the Airzone control system (manual mode) and, subsequently, using the Eco-Adapt algorithm at its different efficiency levels A, A+ and A++.

With the A++ mode, annual savings can exceed 50% compared to manual mode.

	AC UNIT USAGE MANUAL MODE	AC UNIT USAGE A MODE	AC UNIT USAGE A+ MODE	AC UNIT USAGE A++ MODE
Consumption (kWh/year)	4,122.00	2,885.40	2,481.50	2,034.86
Expenditure (€/year)	1,236.60	865.62	744.45	610.46
Savings (%)	-	30.00%	39.80%	50.63%

* Calculations based on the assumption that the installation will operate 10 hours per day, 220 days per year and an average electricity price of 0.3 €/kWh according to the average European tariff for 2023.

** The units considered are Daikin fan coil units with an Altherma 3 EPGA16DV production.

AC UNIT	RATED CONSUMPTION (cooling) (kW)	RATED CONSUMPTION (heating) (kW)	ANNUAL CONSUMPTION (cooling) (kWh)	ANNUAL CONSUMPTION (heating)
EPGA16DV	3.42	3.45	2,052.00	2,070.00

European reference standards

The use of heat pumps in conjunction with Airzone control systems is in line with various regulations, standards and certifications that have emerged in recent years. In this respect, Directive 2009/28/EC of the European Parliament and of the Council recognizes aerothermal energy as a renewable energy source. Furthermore, Airzone's zoned management optimizes operation and reduces energy consumption, resulting in significant cost savings and a lower carbon footprint.

- **Energy efficiency and economic savings.** Thanks to their reversibility, heat pumps can be used for both heating and cooling, as well as in domestic hot water (DHW) systems. This versatility is complemented by the integration of zoned systems, such as the Airzone system. According to a study conducted by the University of Malaga in different European cities, zoned systems can reduce the required capacity of air to water units by between 17-50% for cooling and 9-27% for heating. This reduction in capacity translates into lower installation costs and a significant reduction in energy consumption.
- **Environmental impact**. The efficient use of heat pumps and zoned systems also contributes to the reduction of CO2 emissions and is in line with the environmental and sustainability objectives established by the European Union.
- **Regulatory compliance and certifications**. The integration of Airzone systems with heat pumps contributes to the achievement of A/B classifications in the HVAC control section of the EN ISO 52120-1:2022 standard “Energy performance of buildings. Contribution of building automation, controls and building management. Part 1: General framework and procedures”. This regulatory compliance entails a number of benefits, including: energy savings, reduced operating costs, increased market value of the property, access to voluntary certification programs (LEED or BREEAM) and tax and financial incentives.

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Reference works

Villa Ayantam

Villa Ayantam stands out for its exceptional design and eco-responsibility approach. This stunning residence has been rated “Outstanding” by BREEAM, the gold standard for sustainable building design, construction, and operation worldwide. By integrating Airzone's cutting-edge HVAC solutions, Villa Ayantam not only meets but surpasses the stringent BREEAM standards.

The villa features an advanced HVAC system with over 16 air conditioning units, including direct expansion (DX) and air-to-water systems, along with a 450m² zoned underfloor heating and cooling system. The system is managed by Acuazone, Airzone's advanced HVAC solution, which efficiently controls heating, air conditioning, fan coils, split units, underfloor heating and cooling, and radiators across up to 32 zones. This makes it the go-to solution for large and complex projects.

Building: Villa Ayatam by S&H
Location: Marbella, Spain
Airzone solution: Acuazone
Developer: S&H (Sun Coast Real Estate)

Builder: Aryon Buildings
Project: Ingemantec engineering
Design: OÖD Architects
Facilities engineering: Peláez Ingeniería

AIRZONE

Designed and manufactured in Europe

Parque Tecnológico de Andalucía
Marie Curie, 21 · 29590 Malaga, Spain

airzonecontrol.com · +44 330 822 0991
projects@airzonecontrol.com