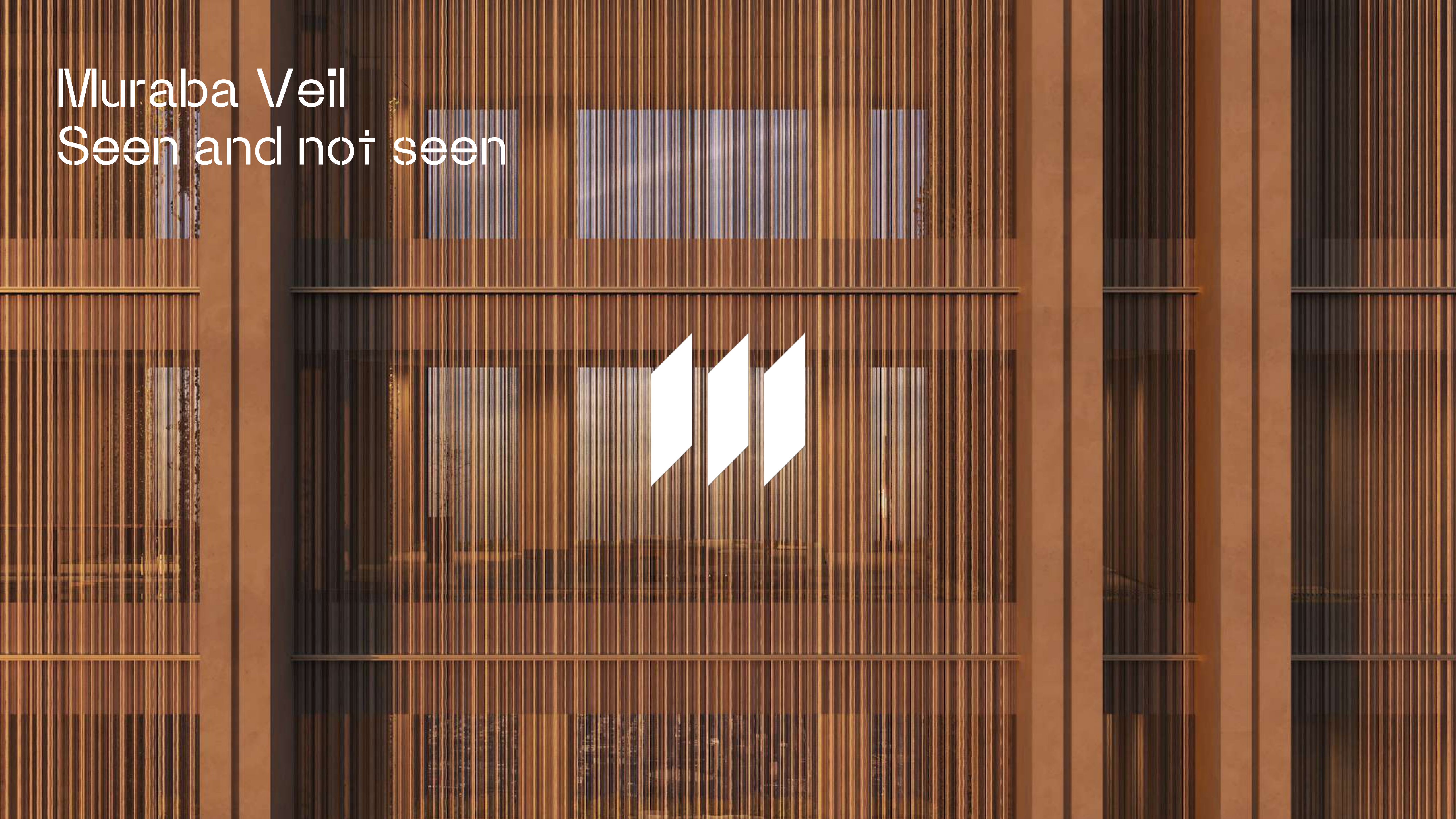
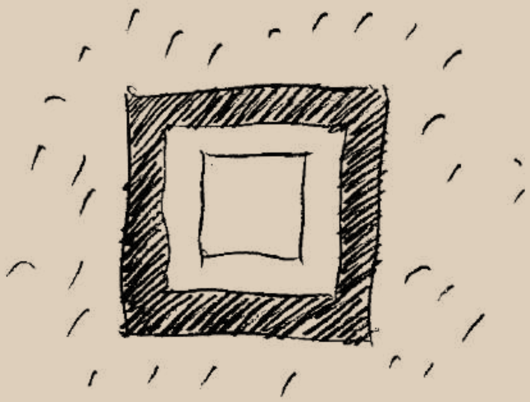
Muraba Veil
Seen and not seen





To reimagine the kind of homes the Veil might accommodate, RCR and Muraba sought inspiration not from the latest comparable developments around the world, but from forms of habitation that have developed in the region they were building in, for centuries.

The traditional Middle Eastern home evolved to offer a cool, comfortable, private refuge from the harsh world outside. The heart of the house was the courtyard, an indoor/outdoor space that allowed the family to gather among gardens and water features. Larger houses included galleried walkways around the central space, offering a place to enjoy natural shade and filtered sunlight. And inside the house, rooms were kept cool by natural breezes passing through openings in the walls on both sides.

Like the diaphanous layers of protective fabric used to create elegant Bedouin garments and tents, this 'architecture of the veil' revealed little to the world outside, but provided a gradient of progressively more protected, private spaces that was perfectly adapted to the Middle Eastern climate.

The idea of a layering of spaces and entrances, from the desert heat through shaded gardens towards the welcoming, private comfort at the heart of the home, is a principle that has had a profound influence on the design of the Veil.

RCR proposed the idea of the 'hybrid space':
a climate cushion between the internal living space and hot Emirati sky running the length of each residence on both sides. Just like the traditional courtyard, the hybrid space is open to the sky and utilises screens of vegetation and pools of water to temper the air as it enters, instilling an atmosphere of shade, calm and freshness.

Technical summary of energy in the Muraba Veil building

The Muraba Veil project has been conceived as a high-performance, energy-efficient residential development in Dubai, aligned with the Dubai Green Building Regulations (Al Sa'fat) and comparable international benchmarks such as BREEAM and LEED.

Its design integrates passive and active energy-saving strategies, with measurable targets for façade performance, HVAC efficiency, lighting consumption, renewable energy generation, and water management.

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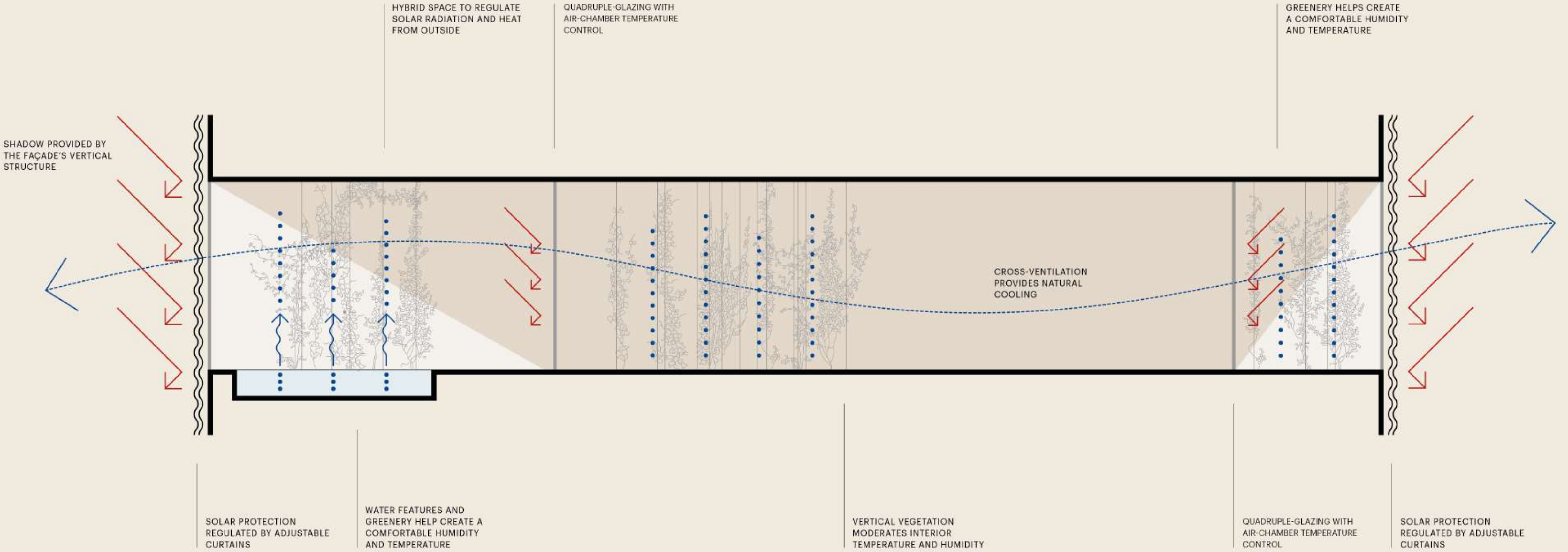
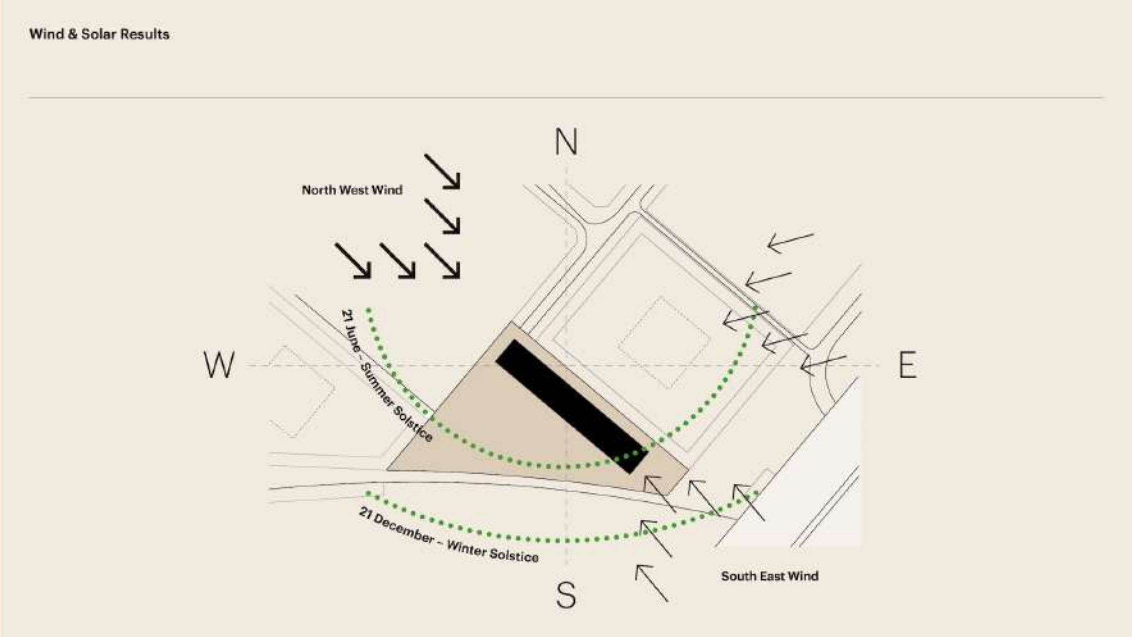
Façade and envelope performance

Solar radiation is the radiant energy, mainly in the form of electromagnetic waves, emitted by the sun that reaches Earth. It includes visible light, which allows us to see, as well as invisible ultraviolet (UV) and infrared (IR) radiation that provides heat. This energy is fundamental to Earth's climate, ecosystems, and hydrologic systems, and it is the primary source of energy for life on our planet.

At Muraba Veil, direct solar radiation is reduced by up to **40% on east and west façades** and **25% on south façades**, translating into reduced peak cooling loads by approximately **15–20%** compared to a standard glazed façade.

Courtyard Layers Scheme

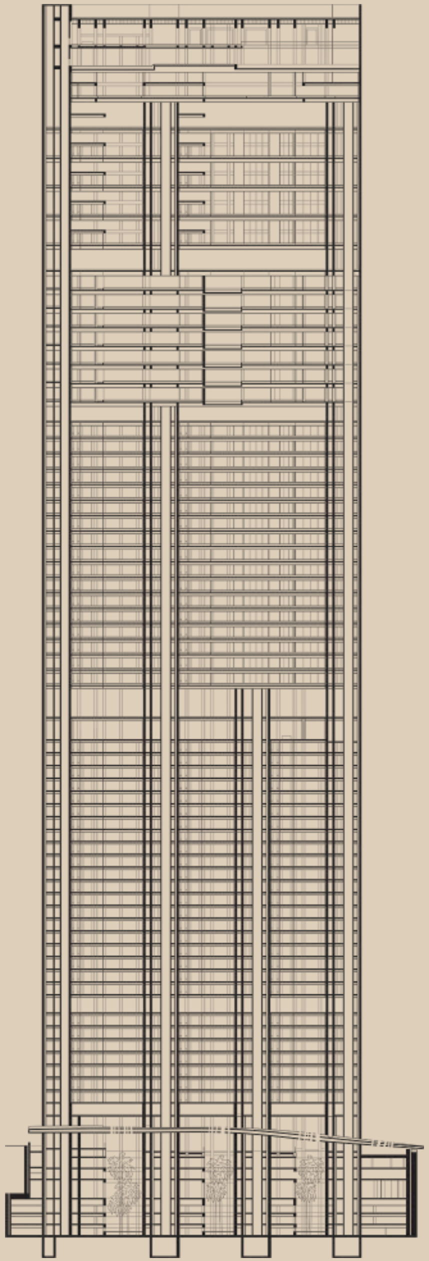




Building orientation and passive design

Solar exposure is the total amount of solar energy that falls on a horizontal surface, often measured in megajoules per square meter (MJ/m^2). It is influenced by factors like cloud cover, humidity, and the position of the sun throughout the day and year. Monitoring solar exposure is important for weather forecasting and understanding climate patterns.

The project optimises building orientation to reduce East–West exposure. Modelling studies demonstrated that this orientation strategy, combined with the external veil, reduces solar exposure by up to 18% annually. Operable façade elements enable natural cross-ventilation during the winter and shoulder seasons, potentially offsetting mechanical cooling demand by up to 10% annually.



HVAC systems

HRV's

In HVAC, HRV stands for Heat Recovery Ventilator, a system that improves indoor air quality and energy efficiency by continuously exchanging stale indoor air with fresh outdoor air while recovering heat from the outgoing air to warm the incoming fresh air. An HRV unit features a heat exchanger with two fans, separating the air streams to transfer heat and pre-condition the incoming air, reducing the load on your home's cooling system and improving overall comfort.

Heat recovery ventilators (HRVs) with an efficiency of 75% reclaim energy from exhaust air, reducing cooling load from fresh air intake by up to **30%**. CO_2 sensors enable **demand-controlled ventilation**, lowering fan energy use by **25%** compared with constant air volume systems. Chilled water pumps and condenser water systems use **variable frequency drives (VFDs)**, which reduce pumping energy by **35%** relative to constant-speed alternatives.

VRF

VRF, or Variable Refrigerant Flow, is an HVAC technology that provides efficient heating and cooling by varying the amount of refrigerant circulating in a system to precisely meet the needs of different zones within a building. This allows for simultaneous heating and cooling in different areas and individualized temperature control, leading to energy savings and improved comfort.

The building employs **Variable Refrigerant Flow (VRF) systems** with inverter-driven compressors, achieving a **seasonal energy efficiency ratio (SEER) of 5.6**. This represents a **20% improvement** over the ASHRAE 90.1 baseline. Each apartment has independent zone control, ensuring cooling and heating match occupancy patterns.

Lighting systems and daylight integration

LED lighting refers to the use of light-emitting diodes (LEDs) as the source of light. LEDs semiconductor devices that convert electricity into light through a process called electroluminescence. This technology offers significant advantages over traditional lighting, including high energy efficiency, a long lifespan, durability, and instantaneous brightness, making LEDs a leading and rapidly developing form of solid-state lighting.

Muraba Veil uses **LED lighting** throughout, with average efficacy of **110 lumens/W** and lighting power densities (LPD) limited to **6 W/m²**, which is **40% below ASHRAE 90.1 limits**. Automated daylight dimming controls and occupancy sensors cover **95% of the regularly occupied spaces**.

Daylight simulations indicate that **70% of occupied floor areas achieve daylight autonomy (DA300lx, 50%)**, reducing reliance on artificial lighting during daytime.

Renewable energy integration

Photovoltaic (PV) panels, also known as solar panels, are devices that convert sunlight directly into electricity using the photovoltaic effect, where light particles (photons) strike a semiconductor material, dislodging electrons and creating an electric current. These panels are made of multiple photovoltaic cells connected together to form a larger unit (a module or panel), which can then be used to power homes, businesses, or even contribute to the national grid

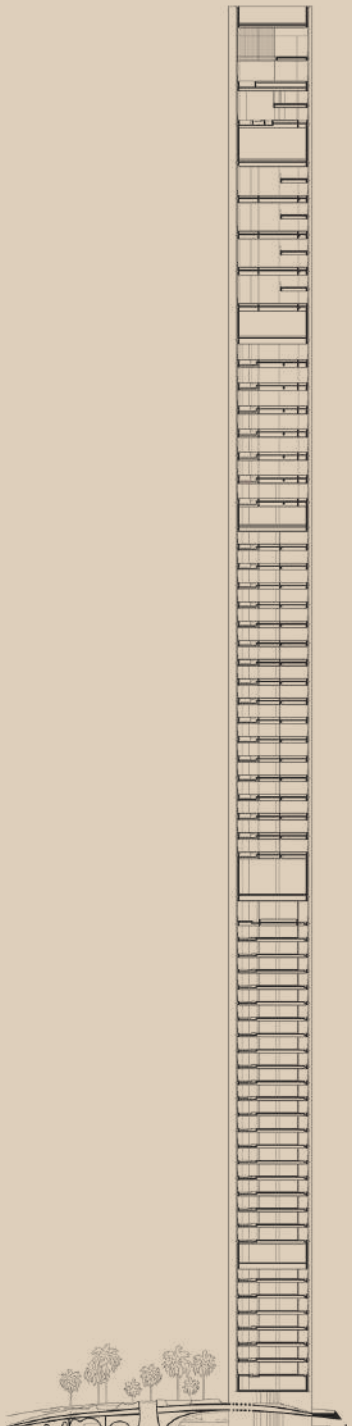
The project incorporates **rooftop photovoltaic (PV)** panels with an installed capacity of **45 kWp**, generating approximately **73,000 kWh annually**. This offsets **7–8% of the building's annual electricity consumption**, equivalent to a reduction of **35 tonnes of CO_2 emissions per year**. Solar thermal collectors provide **60% of domestic hot water demand**, reducing natural gas and electricity consumption for water heating.

Vertical transportation

Vertical transportation refers to the systems and mechanisms that allow people and goods to move between different levels or floors of a building or structure. Common examples include elevators, escalators, moving walkways and stairs. These systems are essential for efficient circulation within modern buildings, ensuring safety and accessibility for occupants and visitors.

The tower contains 21 passenger lifts across multiple cores, supported by service elevators of 1,600–2,000 kg capacity. Energy efficiency is embedded in:

- Standby mode for lifts, reducing power draw during inactivity.
- Regenerative drives, capturing braking energy and feeding it back into the building grid (anticipated though not explicitly detailed).
- Destination control technology, grouping passengers efficiently and reducing unnecessary trips.



Water efficiency and impact on energy use

Water efficiency is the use of strategies, behaviors, and technologies to accomplish a task with the least amount of water necessary, thereby reducing waste and ensuring a reliable water supply for current and future generations. It differs from water conservation in that efficiency focuses on getting the same result (like a clean dish) with less water, rather than solely restricting water use

Low-flow sanitary fixtures reduce potable water consumption by 35% compared with baseline usage. Efficient booster pumps with VFDs cut pumping energy demand by 20%. A greywater recycling system supplies irrigation for landscaping, reducing demand on mains water by 25%.

Controls and building management systems (BMS)

A Building Management System (BMS) is a computer-based control system that monitors, controls, and optimizes a building's mechanical and electrical equipment, including HVAC, lighting, fire, and security systems. By collecting data from sensors and connecting various building systems to a central platform, a BMS enables facility managers to automate operations, enhance comfort, improve energy efficiency, reduce costs, and ensure safety

A centralised **Building Management System** integrates control of HVAC, lighting, shading, and water systems. Predictive algorithms use weather forecasts to pre-condition spaces, improving HVAC efficiency by **up to 12%**.

The BMS allows motorised control of the external veil, adjusting in real time according to solar position and occupancy. This automated adaptability ensures shading is optimised, reducing cooling energy demand by **up to 8% annually** beyond the static design.

Thermal and acoustic comfort

Thermal comfort is the feeling of not being too hot or too cold, determined by air temperature, air velocity, humidity, and radiant temperature, significantly impacting health, well-being, and productivity. Acoustic comfort is the absence of unwanted noise and the presence of desirable sound conditions, ensuring that sound levels and qualities don't hinder communication, concentration, rest, or overall comfort

The recessed façade provides indoor operative temperatures within the range of **22–25°C** for **95% of occupied hours**, without excessive reliance on mechanical cooling. Acoustic insulation performance achieves **Rw 40 dB**, reducing external noise penetration and indirectly lowering occupant demand for conditioned, closed-window operation.

Material selection and embodied energy

Embodied energy refers to the total amount of energy consumed to produce a product or service, including the energy needed for raw material extraction, manufacturing, processing, transportation, and delivery. It's the energy "embodied" in the item itself and represents the "upstream" or "front-end" component of a product's life cycle, distinct from energy used during its operation or disposal. Understanding embodied energy helps compare the energy costs of different products and make more sustainable choices

Materials were selected for low embodied carbon and durability. Recycled content accounts for **20% of construction materials**, while **30% were sourced within 500 km**, reducing transport emissions. Finishes were specified for low VOC emissions, improving indoor air quality and reducing health-related HVAC loads.

Certification and modelling results

Energy modeling is the creation of virtual, computational simulations of buildings, systems, or entire energy systems to analyze, predict, and optimize their energy use and performance. By replicating real-world conditions, these models help users understand factors affecting energy consumption, identify opportunities for improvement, and make informed decisions to enhance energy efficiency and sustainability through scenario analysis and mathematical optimization.

Energy modelling (IES VE software) indicates that the Muraba Veil achieves an **Energy Use Intensity (EUI) of 105 kWh/m²/year**, representing a **27% reduction** compared to ASHRAE 90.1 baseline values. The building is designed to achieve **Al Sa'fat Gold certification** and meets the criteria for **BREEAM Very Good**.

Conclusions

The Muraba Veil project exemplifies a rigorous and data-driven approach to energy efficiency in architecture.

Through the combination of high-performance façade systems (U-value 1.6 W/m^2K, SHGC 0.27), optimised orientation, efficient HVAC (SEER 5.6, 75% HRV), advanced lighting controls (LPD 6 W/m^2, 110 lm/W LEDs), renewable energy systems (45 kWp PVs, 60% solar thermal hot water), and intelligent BMS integration, the building achieves an operational energy performance significantly above regulatory baselines.

Supporting strategies in water management, material selection, and acoustic performance reinforce the sustainability framework, ensuring reduced operational costs, improved occupant comfort, and long-term resilience.

By embedding efficiency in every layer—from passive shading to smart controls—the Muraba Veil stands as a benchmark for energy-efficient residential developments in Dubai, balancing architectural expression with measurable environmental performance.