**2021 ASHRAE LowDown Showdown - Agua Viviente**

Villa Al Mar (VAM) boasts 61,756 SF of conditioned space and 10,607 SF of outdoor space designed to facilitate a visually optimized oceanfront residential living experience and convenience for residents, visitors, and community members. The forefront of our design was choosing a site location which emphasizes resiliency, energy production, and community engagement. This building design not only instills a desire for family members and locals to visit frequently but serves as a resilient structure to protect and serve during a natural disaster. This five-story senior living facility encourages interaction by allowing rooms to flow directly into a protected central atrium allowing access to dining, flex amenity spaces, and accessible healthcare services. The amenity/programmatic spaces are all centrally located so residents can obtain safe access and shelter together during extreme weather conditions. The residential care center boasts a grandiose atrium entrance which features a simulated water fall and four-story living wall that blends state-of-the-art appeal into an outdoor rainforest aesthetic. Net zero energy operations is achieved through energy generation from an integral power generation system comprehensively designed to provide power in both sunny and inclement weather conditions. This is achieved by a translucent panel PV array that both functions as a solar collector and rain water catchment system. The rain water is funneled to an opening and delivers it to a hydro-power generation fountain; installed in the atrium waterfall display.

The site location for VAM was predicated on criteria using ESRI SafeGraph data for: historical hurricane tracks, senior well-being, total population, emergency response time weather and energy generation potential. The area surrounding Aguadilla was quickly identified as a favorable site due to fair weather, ageing general population and access to amenities. Designing the VAM facility on an oceanfront property was paramount, therefore only coastal sites were taken into consideration. Of the site complexities, hurricane tracks and senior well-being were the most heavily weighted, followed by total population of the region. Aguadilla is one the few locations on the island not in the direct path of traditional hurricane trajectories.

Design prioritizes passive thermal control and ventilation and a water cooled VRF with ERV was selected through Parametric Analysis to handle the supplemental duties. The diverse ventilation system functions on enhanced variability and utilizes Barometric Dampers to prioritize availability of natural ventilation from building integrated stack effect. The building façade includes a rainscreen cladding system which includes 3” of continuous rigid. BioCrete was chosen as the primary building material for its strength and negative carbon footprint as well high thermal mass potential. French drains are incorporated in the central atrium to facilitate emergency drainage and critical building systems are located on the upper floors further enhancing resiliency. Storm/hurricane rated windows are used exclusively for exterior exposures and the high mass structure ensures security for occupants. Additionally, the 3-stage water turbine will generate an abundance of power during a hurricane which will maintain facility operations until the natural event passes.

Hydropower Fountain: The hydro-electric fountain design began with the fundamental principle of potential energy storage. Using a similar principle to the Energy Vault technology, we utilized abundant rainfall and the weight of water to our advantage. When the fountain is full of water, it can hold 71,000 lbs. of water. Allowing the fountain height to fluctuate 3 feet vertically, this provides 323,000 Joules of usable potential energy each time that the fountain is full. Using average rainfall of 60 inches per year, our roof design gave us a collection area of 16,500 square feet, allowing us to capture approximately 5,168,000 lbs. of water per year. This average condition provides enough water to cycle through ~72 full fountain loads per year. Power generation was calculated at a conservative 60% efficiency, which includes motor and gearset inefficiencies. This same efficiency value was used when calculating the energy expended to lift the empty fountain - 8,200 lbs. - back up to the top to prepare for a new load of rainwater. The benefit of the system is that extra energy can be stored in batteries or used by the facility, but the fountain itself can function as a battery for emergences but holding the fountain full at the top position and releasing as emergency power is needed. The benefit of a rain-powered system becomes very prevalent in emergency situations such as hurricanes, when the fountain can fill to full capacity in only 10 minutes of hurricane-rate rainfall (5” per hour). This allows the system to function as a reliable powerhouse in the event of grid power outages and can even supply power back into the grid bolstering the regions power supply.