



U.S. DEPARTMENT OF ENERGY SOLAR DECATHLON
Project Summary and Public Exhibit Materials
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Description of Team House

Mojave Bloom creates an oasis from the bustling downtown of Las Vegas and the Mojave Desert's harsh environment. Drawing inspiration from the traditional Islamic *sahn*, or courtyard, this house turns inward, sheltering the resident from heat and noise, achieving a model of alfresco living otherwise unattainable in the southern Nevada climate. The house is a place of healing for veterans who suffer from the effects of post-traumatic stress disorder and traumatic brain injuries. Mojave Bloom empowers occupants to reconfigure the home as needed, adapting to weather conditions, social activities, and their needs for connection or refuge while healing from trauma.

Design Philosophy and Target Market

Team Las Vegas is proposing an elegant, sustainable, and innovative net-zero home design as part of the 2020 Solar Decathlon supported by the Department of Energy and the National Renewable Energy Laboratory (NREL). The home will be constructed and tested at the 2020 Solar Decathlon Build Challenge National Showcase in Washington, DC. Imagine a home that captures energy instead of reflecting sunlight; one that filters greywater and sequesters carbon in its vegetation and soils; one that gives back to the ecosystem in which it resides. The design philosophy imagines a new type of home that could transform the housing market in Las Vegas. The house incorporates all of the high-tech opportunities available, without focusing the design on these systems. The systems will support the project's conception, rather than being its driving force.

The conceptual design that Team Las Vegas has developed is called Mojave Bloom. It is a self-sufficient structure designed as an affordable home for one of our military veterans. Environmental technologies and renewable energy combine to allow the users to live grid-free in a place of their choosing without having to give up modern comforts.

The final outcome from the project will be a home that is used in the competition and eventually brought back to Las Vegas for continued use and testing. Team Las Vegas considers our core mission remembrance and support for our veterans. Mojave Bloom's final destination is Las Vegas Community Healing Garden. The garden features a Remembrance Wall memorializing October 1st shooting victims. Several best practices have been identified to provide for successful housing, including:

- Providing a safe and secure environment with the use of monitoring and diagnostic technologies and screens.
- Offering a sense of autonomy through spatial design and deliberate furniture and fixture selection
- A careful balance between public and private spaces
- Stimulation of both the senses and intellect with the integration of social and activity spaces, abundant landscaping and daylighting
- Using best practices to ensure the physical design addresses the needs of occupants who may have post-traumatic stress disorder (PTSD) and physical limitations due to their military service

Developing an effective design for the harsh climate of the Mojave Desert presents its own unique set of challenges which were addressed with their own relevant design approaches:

- Building orientation to maximize daylighting and minimize heating loads
- Use of bifacial photovoltaic panels for increased renewable energy production and outdoor shade
- Overhangs, screens, and landscaping to further create shade and prevent harsh direct light
- Careful location of glazing and operable systems to manage passive ventilation
- Use of native vegetation, greywater management for efficient reuse
- An edible garden, living fences and screening for perceptual and psychological restoration, as well as general health maintenance.

The house is designed to be a place of healing and respite for veterans suffering the adverse effects of wartime trauma. The home connects the resident to their environment through a carefully orchestrated procession of sensory experiences. Embracing the renewing warmth of early morning sun to the east, capturing the breezes originating in the nearby mountain ranges

to ventilate the home and fill it with the gentle scent of earth and herbs, while drawing attention to our most precious and scarce resource with the faint sound of trickling water.

Unique House Features

Mojave Bloom creates an oasis from the bustling downtown of Las Vegas and the Mojave Desert's harsh environment. Drawing inspiration from the traditional Islamic sahn, or courtyard, this house turns inward, sheltering the resident from heat and noise, and achieving a model of alfresco living otherwise unattainable in the southern Nevada climate. Designed to be a place of healing and respite for veterans suffering the adverse effects of wartime trauma, the home connects the resident to their environment through a carefully orchestrated procession of sensory experiences. Embracing the renewing warmth of early morning sun to the east, capturing the breezes off the adjacent mountain ranges to ventilate the home and fill it with the gentle scent of earth and herbs, and drawing attention to our most precious and scarce resource with the faint sound of trickling water, the experience the home creates celebrates the rituals of daily life in the desert.

Its inner courtyard is bathed in diffused light, filtered through the canopy of bifacial photovoltaic panels above. The living green walls flanking the space cool the dry desert air via evaporative transpiration, and the recaptured water circulating through the hydroponic system emits the meditative sound of trickling water through the space. Raised planters offer additional seating throughout the space, the tall grasses within adding a vertical visual element, their swaying in the wind creating a deep sense of calm associated with non-rhythmic sensory stimuli.

To combat the southwestern prevailing winds that seasonally whip through the valley, the southern living green wall also acts as a windbreak, planted with heartier desert vines that will stand up to both the wind and the intensity of the southern sun. The sliding living green walls and operable window walls that separate the bedroom and living spaces from the courtyard are designed not only as a way of expanding the living spaces into the outdoor volume, but as an act of empowerment for the user, a catalyst for the healing act of controlling one's environment. This ability to manipulate space allows the resident to shift their home to meet their needs, adapting to the various weather conditions of the Las Vegas Valley, their social activities, and their personal needs for connection or refuge while healing from trauma.

Four monolithic walls give a sense of solidity and envelope the resident with a sense of safety and enclosure. The thickened walls provide the area for deep insulation, helping prevent heat gain/loss through the building envelope and creating a barrier against exterior noise that may trigger PTSD. Carefully placed openings, however, provide a visual reminder to the resident of their connection to the larger environment and community. A clerestory draws the eastern morning sun into the bedroom, regulating the circadian rhythm and helping to address insomnia. The narrow skylights that flank the high ceilings allow glimpses of the passing clouds, tree branches, and the starry night sky while bouncing indirect light down the walls, casting shadows that mark the passing of time throughout the day.

Technological Innovations Incorporated Into the House

Home Automation The UNLV home will have a fully integrated home automation system. This system will be used to monitor and control many of the systems in the home including lighting, heating, ventilation, and air conditioning, the solar thermal system, peripheral electrical components, and the landscape irrigation system. The system will monitor the thermal and electrical energy use, and the water use of the home. The automation system will include a smart device display of the operation of the different systems to advise the home occupants of the status of the systems when they are home or away from the home. The system will monitor the temperature, humidity, and carbon dioxide content of the home and switch between different HVAC systems as required. This will include monitoring the solar thermal storage tank temperature to allow the system to switch to heat pump heating if there is not enough solar heat for radiant heating. It will also disable the on-demand water heater if there is sufficient domestic hot water. The system will automatically enable the fresh air makeup system for ventilation if the CO₂ content is high. The system will integrate the heat pump and radiant heating systems to allow the heat pumps to operate in a low cooling dehumidification mode and use the radiant system for reheat if needed. A unique concept for the automation system will be to monitor the irrigation system and control the pumps and valve operation. The system will monitor the landscape irrigation requirements and select the pump and valve operation to only water the those plants or planters that need to be watered. This will allow a water load shedding and staggering schedule to meet the needs of the plants from environmental conditions. The automation system will be tied into the load monitoring system of the main panel and into the battery storage status monitoring to allow energy load shedding and sharing schemes to be integrated into the operation of the home. These will be critical to control battery peak loads by staggering air conditioning or car charging loads to not overload the battery discharge.

Solar Thermal System Innovations A unique concept of the installation is when the home is set up two pipe unions located on the header tube of the collectors will be loosened to allow the bottom of the collectors and support structure to be rotated away from the home to set the collectors to the ideal installation angle. Afterwards the unions are tightened and the solar loop is filled.

This installation allows the collectors to be adjusted to the ideal installation angle suitable for different locations. The collectors could also be adjusted seasonally to optimize the heat collected for the needed water use. The bottom of the collectors, angled away from the house, will be protected with a planter located under the collector.

Another unique aspect of the installation is the design of a compact unit that will house the peripheral components of the solar thermal system. This unit will consist of a compact insulated box that will contain the pumps, mixing and fill valves, radiant manifold, and controls of the solar thermal system.

This box will be designed to minimize the space normally needed for this type of system but still have all of the components easily serviceable. The box can be mounted on the wall or on the solar thermal storage tank to minimize the interconnecting pipes of the system. Because the box will be insulated larger components such as pumps, mixing and relief valves, and the radiant manifold will not need to be insulated. The box will also simplify the installation requiring only piping connections to be made in the field. Temperatures monitored for the operation of the system and the system status could be displayed on the access cover of the box. This box

could be made as an innovative product that could simplify the installation of the complete systems on any project.

HVAC Innovations The system will also include an innovative system to condition the fresh air. This unit will be a compact unit that will use Phase Change Materials (PCM) to lessen the effects of outdoor air temperatures and decrease the air conditioning required to heat or cool the fresh air. The compact unit will be designed with integrated filters to remove odors, allergens and small particles from the fresh air to improve indoor air quality. The PCM used is a commercially available encapsulated eutectic salt which are contained in foil packets and are approved for installation in the active plenum. The salts are flame resistant and do not put out harmful gases or fumes when heated. The PCM is designed to “freeze” and “thaw” at 78 degrees F which is ideal for ventilation applications.

Installed in a heat exchanger in the fresh air inlet, PCM will melt in high ambient temperatures and absorb heat from the incoming air. During cooler evening hours the absorbed heat can be rejected to the ambient or used to heat the incoming air allowing the PCM to re-freeze. During colder ambient conditions the PCM can be used for heat recovery and reheat colder incoming air. Testing at UNLV has shown the PCM installed in the active fresh air plenum greatly reduces the energy required to heat or cool incoming fresh air.

A compact unit will be designed to house the PCM heat exchanger and peripheral components such as filters, blower, humidifier, controls, etc. This unit will be located in the mechanical closet and ducted into the condition space. The unit will be controlled by the home automation system that will monitor CO₂, home fresh air requirements, and ambient conditions to optimize operation and indoor air quality.

Green Wall System The proposed green wall system prolongs the time of using the irrigation system compared with other green walls available in the market that are hydroponic dependent and require irrigation cycles of 2 to 5 minutes and 1 of 5 times a day. The use of drought tolerant plants, a new geotextile design and a mix of different substrates and nutrients will allow us to save energy, turning on the irrigation system once a week. This design has been tested indoors and outdoors with less than 2% plant loss. The staggered watering schedule, drought tolerant plant selection, and low emitter gravity-fed drip irrigation will only require a small pump system, reducing the energy use in comparison to other high demand watering systems.

Resilience Innovation Water security is linked with food security. In recent years, drought conditions are affecting not only our crops but also on our city’s livability. The panel quantity, angle, location, and orientation of the photovoltaic system is designed for net zero energy operation, making it self-sufficient if the city’s energy grid is not functioning. Las Vegas’ climate is not conducive to strictly rely on rainwater as an alternative supply of water but must also strategically reallocate and partition the system to take advantage of grey water reuse from the shower and laundry lines to be recycled for toilet flushing and re-irrigation practices. The organization and shape of the building is designed appropriately to utilize passive ventilation and cooling by placing windows respective to annual wind patterns in addition to having native landscape cool indoor and outdoor spaces through evapotranspiration.

In the same way, Veteran's needs and comfort have also influenced building decisions on how we can innovate with our resources (sun, native vegetation, water management, food production). We translated these user needs in several components used in the building, such as solar panels for energy production and outdoor shade, accompanied with a greywater recirculating system for efficient reuse, and an edible garden, and living fences and screening.

The Target Client: How Design Responds to The Market?

Las Vegas is not a one dimensional city. It is a city of enormous growth and diversity, it is a city that is constantly reinventing itself, and it is a city that is world renowned for its hospitality. Our design studio believes that this hospitality should not focused exclusively on the city's visitors, but rather extended to all the residents of Las Vegas.

UNLV's School of Architecture advocates the power of design and innovation to change lives. These instilled values guided our team to look at the Solar Decathlon not only as a chance to address sustainability and environmental concerns, but also as an opportunity to serve the at risk members of our community.

The war in the Middle East is the longest war in US history, and 1/3 of the service members who deploy return with combat induced disability.

The trauma doesn't stop when they return home.

They face years of (re)habilitation, and often these disabilities are the root of even larger issues, including substance abuse, divorce, incarceration, homelessness, and even suicide.

These men and women have chosen to serve their country, and we believe that it is our responsibility as citizens to serve them.

Post-traumatic stress disorder and traumatic brain injury are two of the biggest challenges for veterans. Mojave Bloom accommodates these conditions by demonstrating prospect and refuge principles by providing simultaneous access to outside views without exposing the occupants to onlookers. Mojave Bloom empowers residents by giving them control over their environment to be as open and private as they require. With the gates and adjustable shades over the courtyard windows, residents are free to enjoy the outdoors without sacrificing their privacy. The house's windows and skylight keep our resident connected to the outside world with visual access as well as providing connection to the experience of light and shadows as the day progresses. This connection has been shown to improve sleep cycles, which reduces stress.

Team Organization

See Attachment- A.

Future Plans for The House

The Mojave Bloom's final destination is Las Vegas Community Healing Garden. The garden features a Remembrance Wall memorializing October 1st shooting victims. Team Las Vegas considers our core mission remembrance and support for our veterans. We share the same goals as the Community Healing Garden by “celebrating life, beauty, love, and compassion. Choosing love over fear, life over death, hope over despair. Helping each other heal”. Mojave Bloom will be one of Las Vegas’ flowers that will be added to the garden. Our house will connect the residents with their environment and help healing veterans who suffer from post-traumatic stress disorder (PTSD) and traumatic brain injuries (TBI’s). Our house will highlight the importance of thanking veterans who have sacrificed for our freedom, and will help promote healing veterans and the community.

Final Details for the Team’s Community Exhibition

Mojave Bloom does not have a schedule right now, to be provided later.

Attachment - A

The Team Roster will be submitted as Attachment A separately.