SD2017 Competition Deliverable 3: Team Summary

Submitted 9/15/16
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Team Description

The University of Maryland's team for the 2017 U.S. Solar Decathlon currently includes 170 students, staff and faculty from across the University in Programs of Architecture, Engineering, Libraries, Plant Sciences, Computer Science, Journalism and Business. We are working to forge a significant advancement for residential design and construction -- one based on clean energy, clean water, healthy materials, nutrient recycling, time forward construction resilience and social equity. Our integrated design process incorporates innovative research and technology. UMD's Solar Decathlon house will serve as a seminal prototype for houses that can be readily adapted to a wide range of clients, communities, construction technologies and ecological environments.

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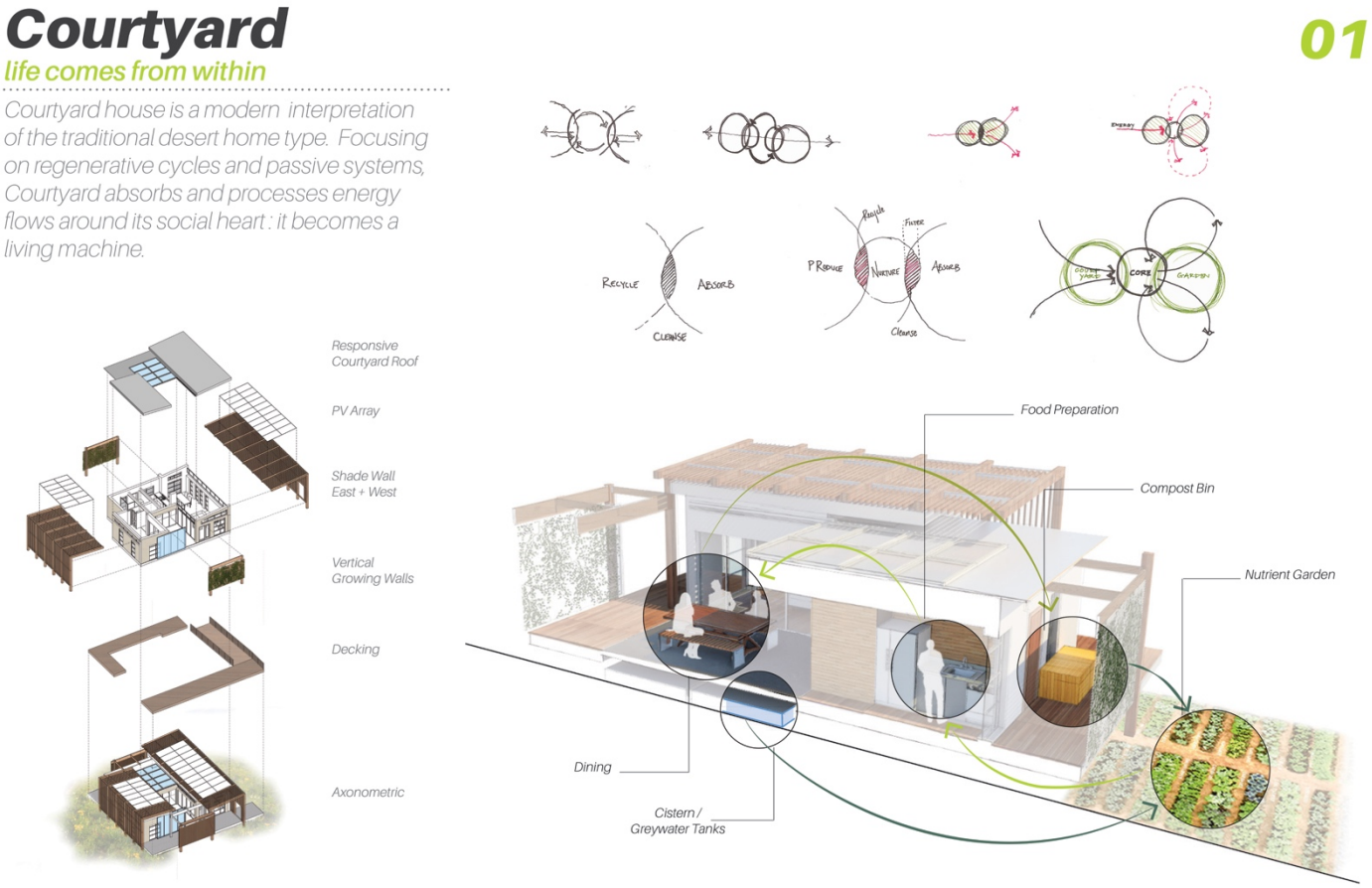
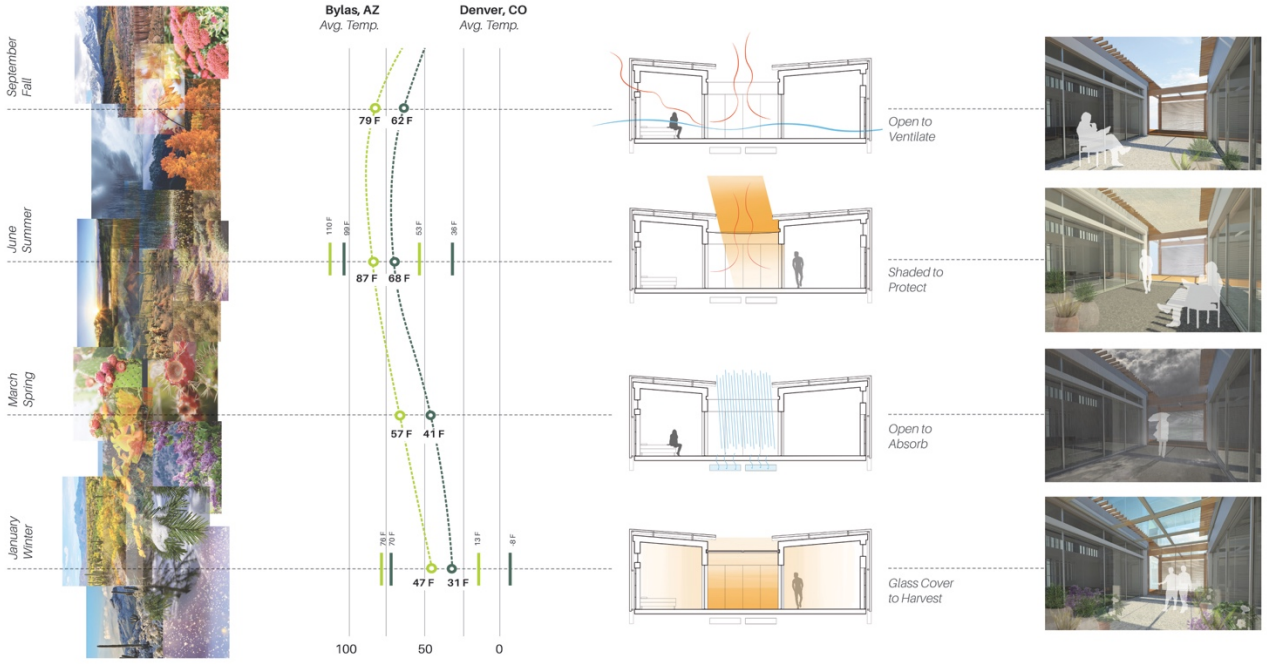
Digital Images



Seasonal Response

Adaptive Courtyard

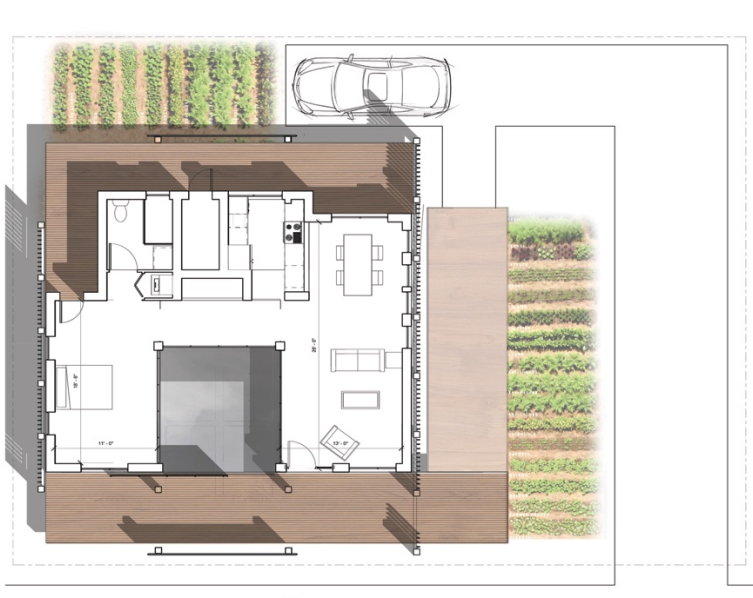
02



Orthographics

Plans | Sections | Elevations

03



Plan | *1/4″=1′*

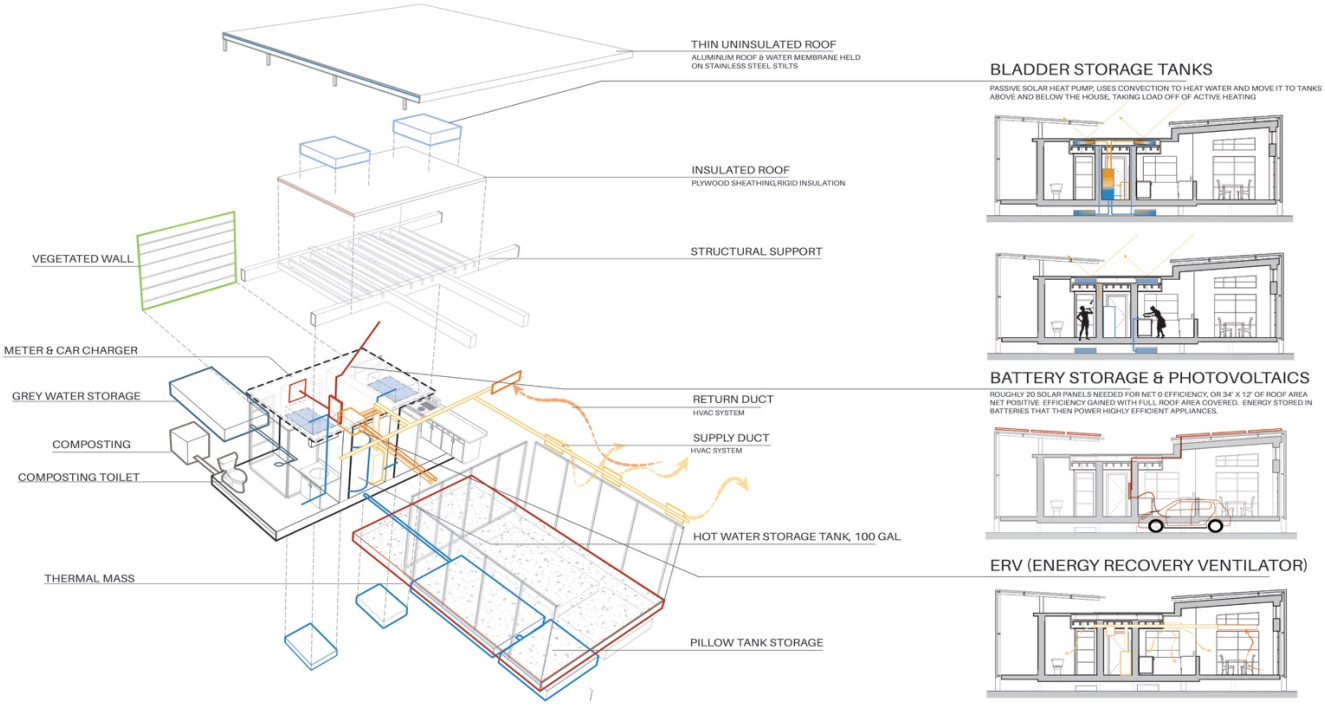
Sections | *1/8″=1′*

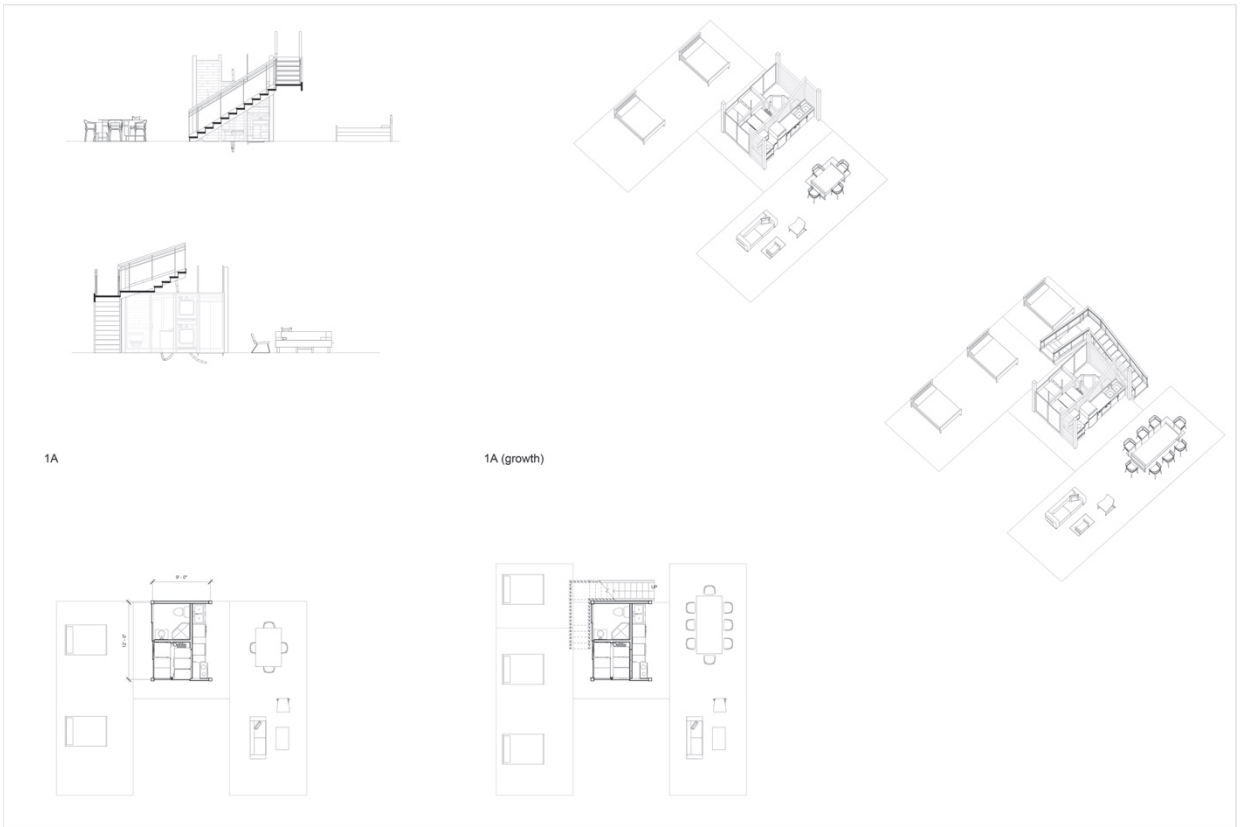
Elevations | *1/8″=1′*

Infrastructure

Structural + Mechanical Systems

04



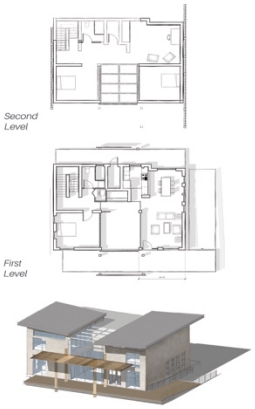


Application

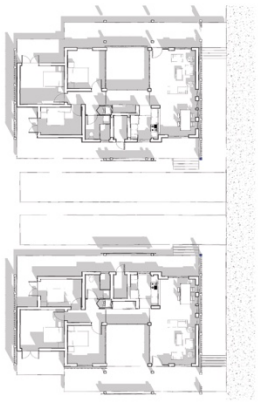
Aggregation, Expansion , + Flexibility

06

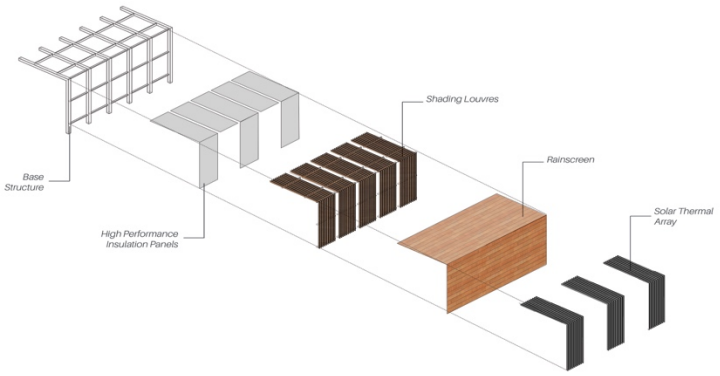
Vertical Expansion



Horizontal Expansion



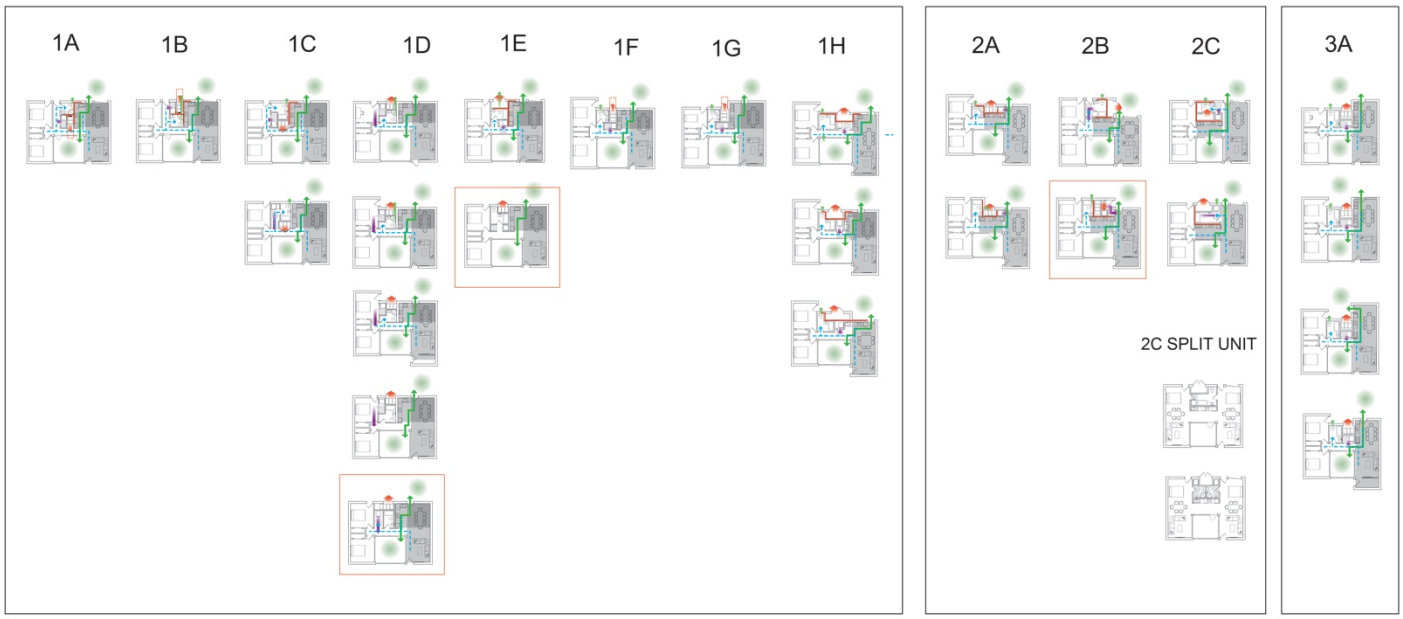
Skin Options



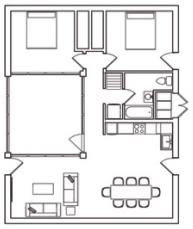
PLAN TYPE 1

PLAN TYPE 2

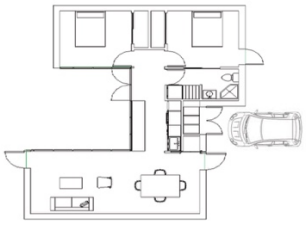
PLAN TYPE 3

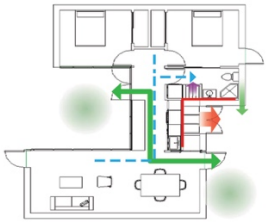


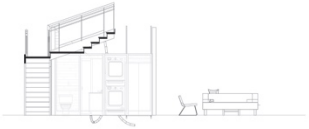
3B



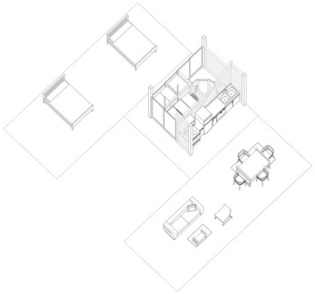
2A

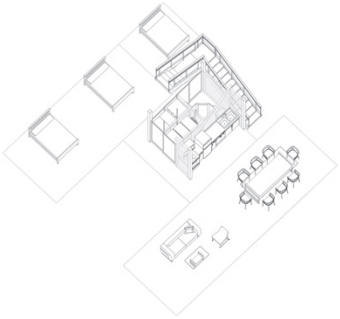




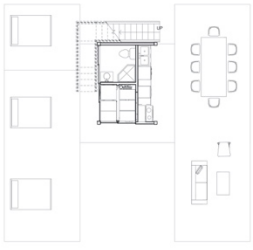


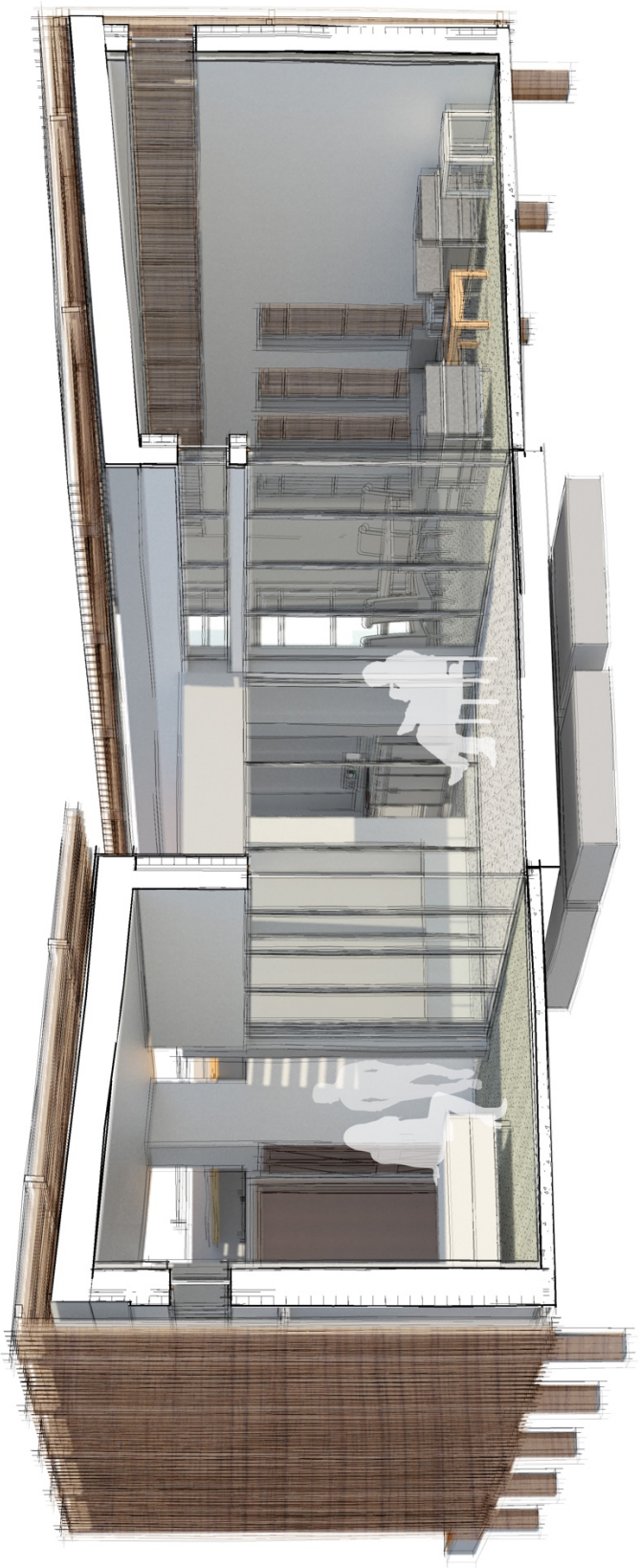
1A





1A (growth)





Team Photograph

Team Photograph, Photo by Cynthia Frank

Left to Right

Row 1: Ana Novo, Renata Southard, Sandra Oh Boun, Alan Uy, Jamey Campbell, Christopher Courtney, Jack Perry, Shaina Rudman, Ry Arnold, James Kim

Row 2: Wadiah Akbar, Patti Cossard, Ray Adomaitis, Ramya Srinivasan, Emily Powers, Saurabh Patel, Natalia Noyes, Emily Goo, Jonathan Jones, Yosef Kebede, Ruth Shatkay, Manu Narayanan, Denise Alving, Renee Adkins

Row 3: Nora Alshareef, Mike Binder, Ilan Goldstein, Nicolas Sarfaraz, Samuel Gollob ,Anil Moore, Aysanew Abate, Kevin Dominey, Andrew Poissant, R. Julian Ivey, Rajesh Nair, Sean Naimi, Jake Morris, Christina Chen

Row 4: Garth Rockcastle, Colin Weber, Saimouli Katragadda, Elisabeth Smith, Jessica Schroeder, Alex Mazze, Malik Johnson Williams, Sophie Habib, John Hunsicker, Rohit Dhumane, Ellery Klein, Noah Vernik, Christiane Jones Machado, Alla Elmahadi

Unique Project Elements & Innovations

Core: Zone of Integration … *connecting flows within and harvesting abundance from above and below*

Attic/Loft Situated above the mechanical room, kitchen, bathroom, and laundry, and courtyard, an elevated solar loft serves as a predominantly passive zone to aid various support functions in the house, such as drying clothes, dishes and food; cooking (a solar oven); storing heat; and UV sterilization. The flexible greenhouse structure over the court and core, will be tied to the intelligent monitoring and controls.

Base/Terra Firma The primary goal of the courtyard space is to serve as the outdoor social center of the house on conducive days, but it also performs as a reservoir (warming on cold days and cooling on hot days) and its important subzone will store grey and potable water. Heat from the sun, and cool from the nights will be harvested then released into the house through intelligent monitoring, and weather forecasting systems.

Water The house is designed to harvest in its core/court zone rainwater falling on the structure, with some filtered and sterilized to potable standards. To reduce the amount of fresh water needed, the house uses systems that filter

and recycle water between drains to sources. Dedicated drains will circulate and store greywater, to satisfy applicable law and building codes. Non-toxic disinfectants will be added as necessary to prevent sepsis. Greywater uses include irrigation, toilet flushing and other 'non-potable' uses. Some will be filtered then subsequently sterilized by UV light to be reused for shower and clothes-washing. These systems will help extend the growing season and support more plants than otherwise could not survive in the harsh high desert climate. Team Maryland is also exploring an indoor hydroponic gardening system that will grow food and be directly accessed from the kitchen.

Waste Transformation

Composting will be an integral part of the team Maryland ecosystem, decomposing edible and decorative plant waste from the landscape, to support the web of living organisms in the soil and to boost its nutrient output. Demonstrating our desire for sustainable, closed loop systems, a composter specific to food waste and yard waste will create nutrient-rich soil for the composting garden located within viewing distance of the kitchen. Since composting can be a lengthy process, partially or fully composted soil samples will be used in the composter and garden for the purposes of the public exhibit. Methods of composting being considered include sealed tumblers, unsealed outdoor bins, and vermiculture (earthworm and microbial) bins. In addition, a commercially available non-operational composting toilet will serve as a public exhibit during the competition. Our toilet may be modified to demonstrate the potential for solar energy to accelerate the disinfection process. Exhibit explanations will include system function, health safety and economic considerations, but also the various benefits of composting toilets such as conserving water, creating soil, and increasing self reliance. We are also researching a residentially scaled bio-gas production system.

Recycling waste flows are ultimately a transformational process, some feasible to on site activity (like composting), with others requiring exportation to more efficient and shared facilities. We are designing innovative receptacles and systems to make this a more educational and fun compliment to domestic activities.

Energy The team's house design has a tightly integrated and cross fertilizing mechanical core, which facilitates recovery and reuse of waste heat, water, air and energy from household activities and appliances. Research on innovative systems to transfer, concentrate and store waste heat for use in domestic hot water heating and desiccant regeneration is progressing. Our Energy Recovery Ventilator (ERV) will interoperate with the Smart House system to draw its stale and fresh air from different locations inside and outside the house depending on current conditions, maximizing comfort and efficiency. Similarly, fresh air will be delivered to different interior spaces depending on occupancy use and other operational factors for maximum health.

Solar The team is researching and developing insights to harness and maximize solar radiation. For instance, the most efficient systems, battery storage and voltage options are being critically reviewed.

Thermal Properties The most ambiguous and unmanaged flows of energy in current residential space are thermal. Through several innovations in our intelligent/smart core and systems monitoring our house will capture, transform and reuse thermal waste (hot and cold).

Electrical Energy Used for heating and cooling the house as well as water heat maintenance, electricity drawn from maximum-efficiency solar panels and storage systems will be integrated to support the house's energy requirements through communication within the SMART house control systems and optimizing independent site/house production.

Human The Maryland Team plans to demonstrate innovative systems for harnessing human movement for energy production, capture, storage, and translation into alternative uses and benefits. We all know human health and well being is enhanced by active exercise and we believe the potential exists to capture some of those benefits for home energy needs. These devices will be located and operated so as not to adversely impact the thermal comfort, energy balance or lighting levels measured during the Competition. Innovative mechanisms will also be used for manually

opening and closing windows, skylights, etc. In some cases, these devises will be manually operated to perform operations when triggered by the house's Smart Control system.

Controls A key technical innovation of our design is the integration of physically based models developed to describe the instantaneous state of the home's power, thermal, and water system dynamics. The team's objective is to create a 'virtual home' that can quantitatively compare design choices and to assess house performance over a spectrum of conditions corresponding to the Solar Decathlon contest period and climatic location. A Model Predictive Control (MPC) system for house-wide management of all electrical and mechanical systems will be installed to allow for enhanced optimization, functionality and comfortability management. The safety monitoring and alarm system integrates the environmental levels to contribute to the system's efficiency. The development of an indoor comfort level objective function that takes into account indoor temperature, relative humidity, radiant temperature, light level, indoor air speed, and chemical composition (e.g., CO2 level) is planned and will be used in the context of our MPC strategy. Appropriate sensors for these quantities will be assessed and/or developed. Dynamic stochastic optimization for the integration of house PV, battery-storage, and power management systems for house use-cases developed from the 2017 SD competition rules and projected weather conditions also builds logically on our modeling work. Our Systems Engineering methods for requirements management and to help systematize the engineering concept development process and initial hierarchical decomposition of the major home components.

Envelope In climates with dramatic seasonal temperature swings, such as in Denver, and the team's home state of Maryland, an adaptive and responsive envelope can respond to various climate conditions amplify a home's performance. Maryland's SD2017 Team is developing a system monitored by Smart Technologies that will adapt to variations in weather by closing or opening the central courtyard space and other envelope features based on comfort conditions and energy harvesting potential. In colder seasons, the courtyard will be enclosed by an insulated glass roof and walls to capture solar gain and disperse the energy throughout the house. Plants can also be brought into the insulated courtyard to extend their growing season and in some occasions provide shade on the most interior spaces. In warmer months, the glazing, greenhouse and/or shading devices will respond, and the courtyard can be sheltered, insulated or open to the sky. The courtyard will not only enhance overall building performance and capitalize on passive and active energy flows, it will also provide a social core and a place of respite and interaction for occupants.

Team Online Presence

Maryland's online presence will utilize many different media to get our message of shifting the housing industry paradigm to an integrated approach to renewable energy, water conservation and waste recycling working in partnership with the natural ecosystem rather than against it. Our online presence will focus on regenerative communities of the future, highlighting our research, design, and engineering with a diverse group of the public. Our website is built upon the Drupal Content Management platform to sustainably use and reuse our content. We have a blog which is used for student updates. Team Maryland will use the social media, such as Facebook, Twitter, Instagram, Vimeo and Youtube, to package and our content to different populations. Our website will feature RSS feeds from these online media and will also push out content as well. We endeavor to collect, use and reuse content in as many outlets as possible without having to manually duplication. The following social media sites have been set up and are actively being used.

Website permanent url: http://solardecathlon2017.umd.edu/
This is an outward looking site, we are developing it now between our Communications Team and our Identity Team.

Blog: http://sd2017.umd.edu/
This was our original online presence used with the courses taught Spring Semester 2016. We are currently repurposing it as a campus and student information site.

Team Interest: http://go.umd.edu/sd2017
We have been very successful with this form to recruit new members. It has allowed us to gather the following team

profile. We currently have 170 students, staff, and faculty team members. 83% are undergraduates, 13% are master's students, and 4% are PhD students. 85% are are in the Clark School of Engineering, 18% are in the School of Architecture, and the remaining 14% is spread over other campus units. There are 45% women and 55% male. We are 55% Caucasian, 21% Asian, 7% African American, 7% Hispanic/Latino, and 5% identified themselves as other, and 5% declined to identify their ethnicity.

Twitter: https://twitter.com/UMD_SD2017
Facebook: https://www.facebook.com/UMDSD2017
Instagram: https://instagram.com/UMDSD2017
Vimeo: https://vimeo.com/user56673471
Youtube: https://www.youtube.com/channel/UCew3P-8tOWcijGKt28jcvew

Public Outreach & Press Coverage Achieved

Outreach programs, social media platforms, and team meetings have been coordinated to support the 2017 house team needs as well as to create an innovative, diverse and inclusive team. Participation and planning of on campus events have centralized the recruitment and outreach components of the team so far. The All Team Kick-Off event allowed members new and old to be inspired to continue to participate in the project. Recruitment events such as the A. James Clark School of Engineering annual picnic and the University's First Look Fair have created a campus presence for the team. Next we plan to reach out to local high schools and boy scouts to be held in conjunction with the Potomac Valley AIA chapter whose headquarter is UMD's 2007 Solar Decathlon entry, LEAFhouse. To date, our recruitment has resulted in 170 team members and are growing daily.

We have registered a "Solar Decathlon" Student Organization with the Student Government Association, whose mission is to raise awareness and interest in the U.S. Department of Energy Solar Decathlon competitions and the University of Maryland's history of participation. The goal is to foster understanding of the Department of Energy's main objective--promoting a cost-effective, energy-efficient, and attractive solar-powered housing industry--and to inspire creative ways of improving the University of Maryland's team when it competes. It is our hope that this student group will exist whether or not UMD competes, providing continued outreach on the issues of renewable energy and energy efficiency.

We have also established a network of campus professional communications officers that are working with us to get our message out through a variety of campus traditional and social media. The student newspaper the Diamondback, is our initial press publication. Bell, Jacob. "Department of Energy selects UMD team for 2017 Solar Decathlon," *The Diamondback*, February 11, 2016.