THE UNIVERSITY OF ARIZONA SOLAR ENERGY EXPERIMENTAL DWELLING

——The University of Arizona students and faculty demonstrate the future of smart design

亚利桑那大学太阳能实验住宅

——亚利桑那大学师生展示智能设计的未来

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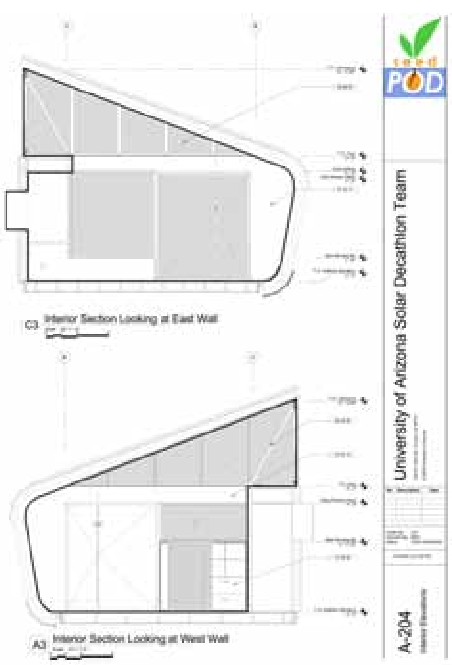


亚利桑那大学建筑与园林学院在太阳能实验住宅（SEED）研究项目中，因其先进的智能设计而声名远扬。

这项实验是该校师生共同构思，并历时 2 年半完成的科研成果。结构上，该项研究研发出了许多新技术和结构部件。10 月，在华盛顿国家广场为期两个星期的展览中，该项设计在各方面获得了高度评价，从而使亚利桑那大学应邀成为世界上仅有的 20 家太阳能全面研究机构的成员之一。

从图片中我们可以看出，每个单体设计有 5 个支架（分别平行安装在两个轨道中），由此组成一个屋顶呈弯型，面积为 63 平方米的可供 4 人栖息的居所。这些模块化的单体连续安装可组成更大的居住空间。

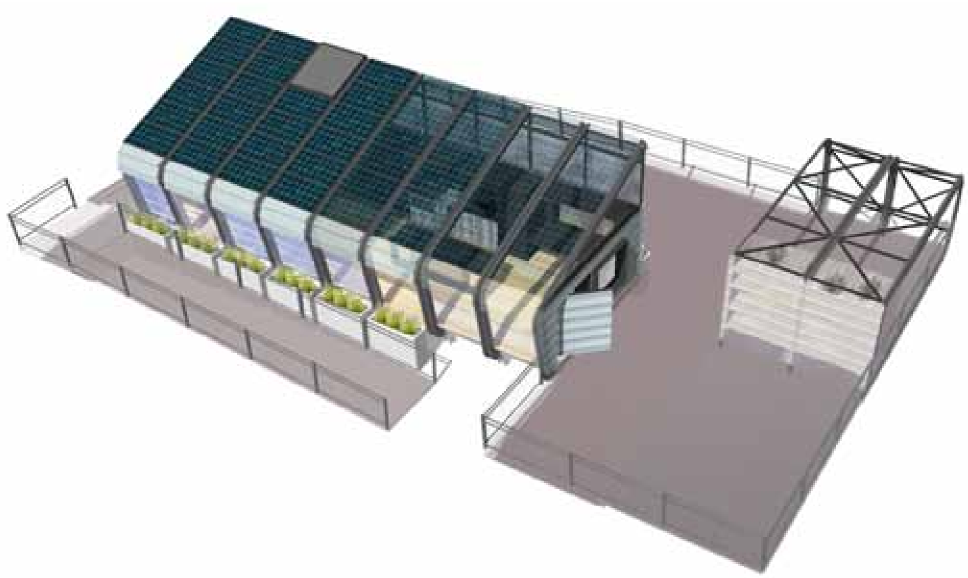
从地面到屋顶连续安装着胡桃木硬质板材和木条，整个住宅给人一种温馨、恭迎的感觉。可开启的整个天窗使整个居室沐浴在南北方向充足的自然光线中。南部可敞开的窗户由众多高 2.13 米、宽 1.28 米的活动窗页组成，窗页可向外推开（东西向的自然风可经此进入，从而可保持居室空气的自然流通），其他可开启的窗户则采取无需常开的策略。

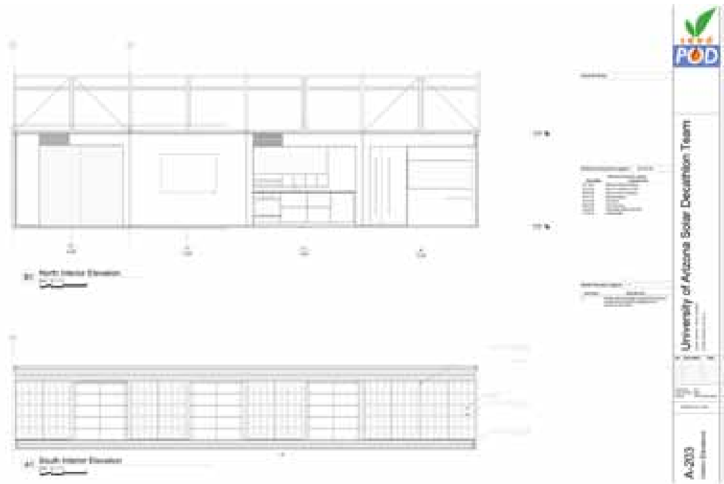
整个项目的面积并不是很大（两个部分重叠的单元构成了一个整体），4.25 米 X12.20 米（14 英尺 × 40 英尺）的设计仍让人觉得很舒适，居住者还是可以很轻便地从室内的一端踱到另一端。轻快而连续的空间以及设计理念体现在每一个弯型模块都通过一个 90 厘米（3 英尺）厚的型心形成无缝机械连接。型心（或脊椎）包括其对面（北面）的模块，并通过一个集合线路、管道、太阳能热水和制冷铜管的装置连为一体。

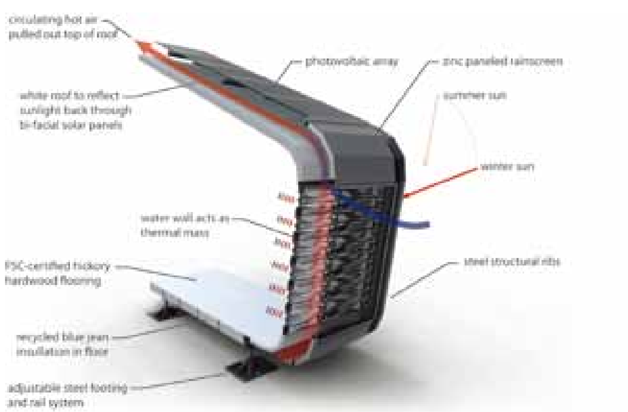
每五个模块编成一组的结构中，包括平板，经激光切割的薄钢板折叠而成的屋肋，这些作为“多功能的建筑构件”承担着各种不同的功用。这些屋肋同时支撑着南立面和屋顶，它们首先由学生用纸板进行初步试验，然后进行金属厚度测算，最后才对薄钢板进行钣金。

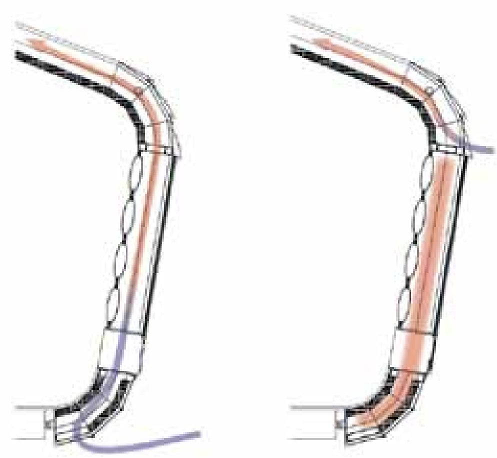
结构的各个组件都通过铰接的方式连接至地板引脚。世界上任何地方的工程建设中，铰链部件一般都安装在外立面（工程最长裸露部分）和屋顶（屋顶有一定的倾斜以便完全安装在屋顶的太阳能板获得最佳采集角度）。这种引脚也使该结构被下调至美国州际标准。这一项目的高度灵活性设计，从而


mechanically operable north clerestory windows
manually operable core windows
lightweight steel structural ribs
zinc paneled rainscreen
FSC-certified hickory hardwood flooring
steel floor structure
modular prefabricated "core" contains kitchen, office, bathroom, and mechanical functions









能使这种太阳能实验住宅能从图森运往首府或全国 3682 公里（2288 英里）的任何地方。

虽然，在这些设置中，无数的概念和元素通过一种巧妙而简单的方式相互作用，最大的亮点还是那惊人的水墙。这面安装在南面作为内饰的水墙，是由无数单个的可回收的塑料容器组成，并通过管道而相互连接为一体，每 10 个塑料收集容器形成一个编组直接连接到一个隐藏在地面容积为 30 加仑的水囊中。

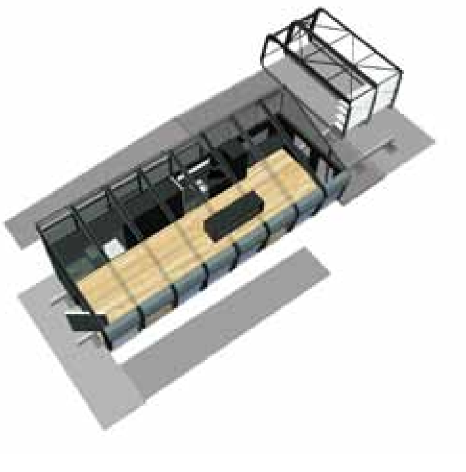
真空泵把水泵到众多的容器中，从而形成一堵液态特朗勃墙（相当于 3 英尺厚的混凝土砖墙），半透明的温水把从太阳中获取的热量释放到人所居住的空间。这些塑料容器，其理想的形状和壁厚是经过学院无数次的物理模型试验，经由数控计算，最后采用真空成型而成的。

该实验住宅南面的窗墙对整个室内的空气流通是整个设计理念中最关键的因素。可开启的百叶（可在冬季关闭）位于南立面底部，架空的地板下收集的热空气因为室外安装的低辐射双层玻璃与室内安装的水墙之间的温差而向上流通。这股通过水墙流通的空气冷却了单个的塑料收集容器，换句话，也就是说以虹吸方式吸收了室内的热量。这股上升的空气然后继续前行，流向太阳能采集矩阵下的一个锥形缺口（文丘里效应），从而使屋顶天花板底部得到冷却。

太阳能采集器是双面都能吸收能量的，即两面都能吸收太阳的光芒。未被吸收的射线穿过面板正面，反射到白色屋顶表面，然后再反射到室内，由面板“背面”吸收利用。尽管经过空气冷却，所吸收的能量仍能达到正常单面面板能量收集率的 35%。

在谈到太阳能实验住宅的围护结构时，主持该项实验的建筑与工程学院教授拉里•迈德林先生指出，这个设计就像是一个选择性的过滤器，让使用者以一种积极的心态与环境中对自己有利的因素形成互动。迈德林教授进一步指出，“我们的目标，就是要营造出一种对自然的理解，从而唤醒我们对自然的责任。”

更多信息，请登录 www.uasolardecathlon.com。



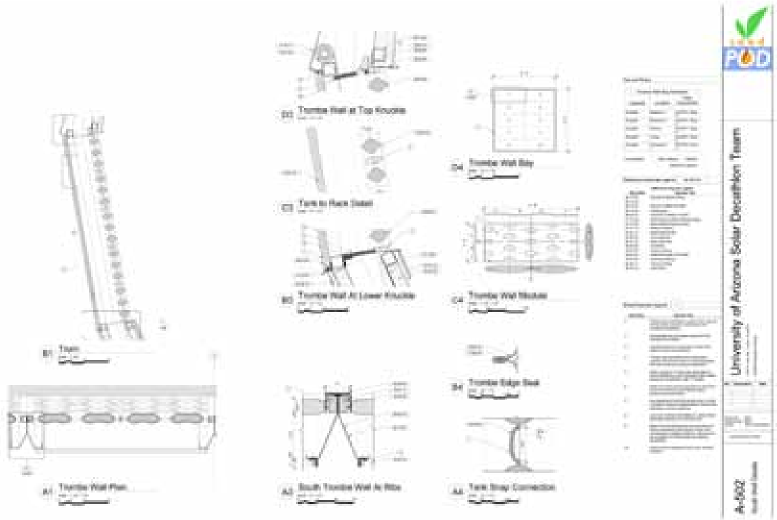
Renowned for cutting-edge intelligent design, the University of Arizona (U of A) College of Architecture and Landscape Architecture (CALA) has further polished its reputation with the Solar Energy Experimental Dwelling, or SEED[pod], project.

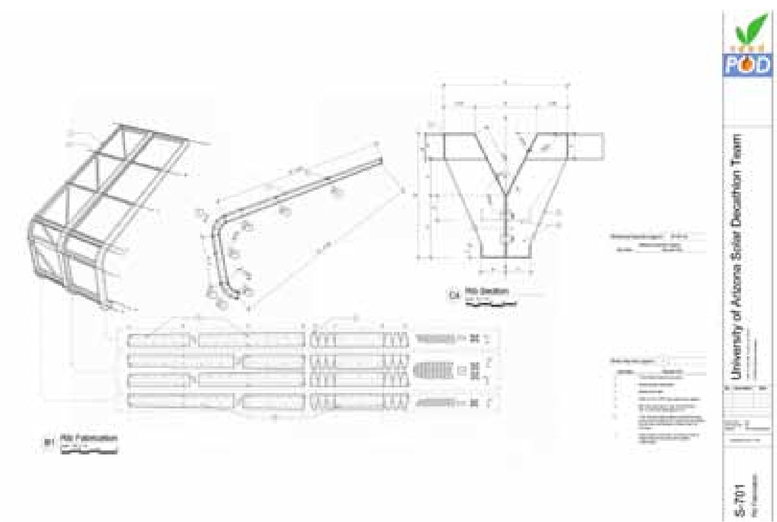
The experimental SEED[pod] is product of a 2½-year campaign joining students and faculty together in conceptualizing the project, researching and developing numerous new technologies, fabricating components and finally assembling the entire structure. The multi-faceted, rigorous and highly disciplined U of A design was exhibited on the National Mall in Washington D.C. for two weeks in October, and was one of only 20 invited worldwide institutions for the U.S. Solar Decathlon.

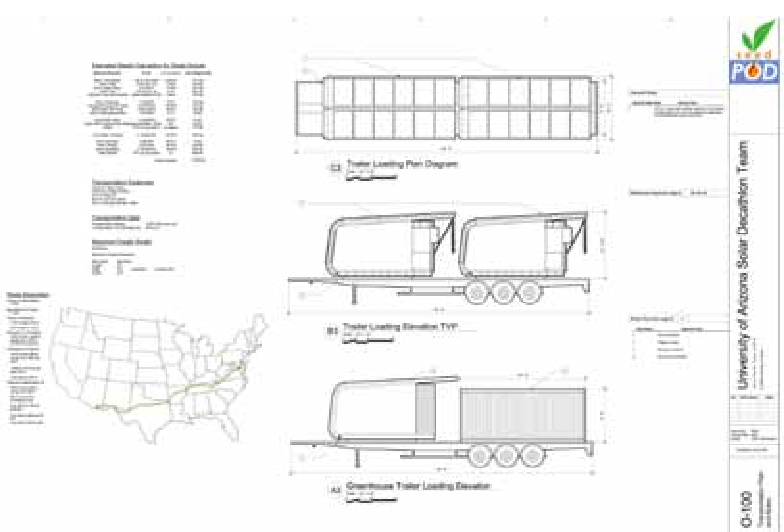
The internationally published U of A project consists of 5 bays (separately mounted on two leveling rails), 4 of which are habitat with one greenhouse. Together the bays form a gesamtkunstwerk consisting of 63 sqm (680 sf) of efficient and forward-thinking modular planning.

The entire dwelling is given a warm, inviting feel, thanks to sustainably harvested, hickory hardwood tongue-and-groove planking on both the floor and the ceiling. The naturally well-lit home is bathed in direct sunlight from the southern exposure and enjoys even northern light from operable clerestory windows across the entire back. Additional operable windows to the south combine with large 1.82 m wide by 2.13 m tall (6 ft x 7 ft) outward-swinging doors (wind scoops) on the east and west ends, which give the space easy cross-ventilation—all part of the project's overall passive cooling strategy.

While the footprint of the zinc (rain screen) clad project is not large (although two partially overlapping units makes it a family affair), the size of the 4.25 m by 12.20 m (14 ft x 40 ft) design is comfortable and flows easily from end to end. The effortless continuity of space and the logic of the parti are evidenced by the seamless mechanical connection of each bay via a 90 cm (3 ft) thick core. The core (think spine) comprises the back (north) edge of the modules, which interconnect with one another via plenum that accommodates wiring, plumbing, solar hot water and copper tubing for refrigerant.







The structure of each of the five modules consists of flat, laser-cut sheet steel that is folded to create skeletal "ribs." Known as "multi-functional architectural components" due to their variety of roles, these ribs simultaneously support the southern façade and roof. They were first developed by students through preliminary cardboard investigations, which progressed to thin gauge metal and finally advanced to full-scale sheet metal.

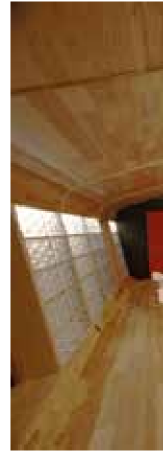
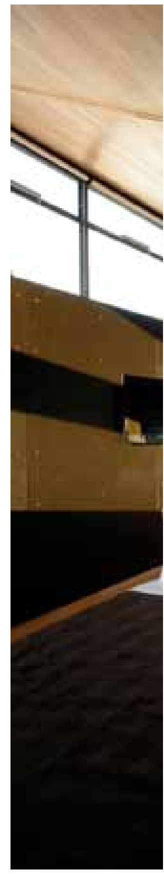
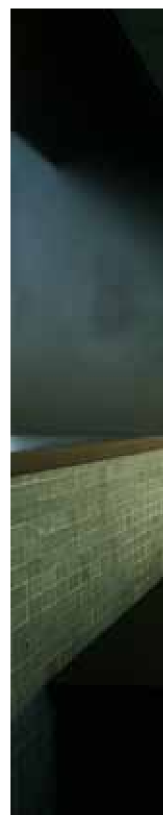
Each of the structural components is hinged via pins to the floor plate. No matter where in the world the project is erected, the hinged elements allow the front façade (the longest exposure of the project) and the roof to be tilted to acquire the optimum solar angles

for the array of photovoltaic (PV) panels mounted across 100% of the roof. The pins also allow the structure to be lowered to the standard US interstate clearance dimension. This flexibility of project height enabled the SEED[pod] to be transported 3682 kilometers (2288 miles) across country from Tucson to the nation' s capital.

Set amid a clever yet simple interplay of numerous concepts and elements, the show's pièce de résistance is the striking water wall, which consists of individual, recyclable plastic panels (containers) mounted to the interior of the southern façade and interconnected via tubes. Each cluster of 10 containers is connected to a 30-gallon bladder hidden in the floor directly below.

A vacuum pump draws water into the containers. Acting as liquid trombe walls (equivalent to 3-foot concrete thermal masses), the translucent water elements radiate warmth into the space from the sun' s captured energy. The form and the amorphous sections of the molded plastic containers were derived after hundreds of hours of computer modeling to obtain the most efficient shape and thickness of plastic and countless physical models created on the University' s CNC-Router and Vacuum Former.

Air flow within the SEED[pod] prototype' s front window wall is another key element of the project' s gestalt. Operable louvers (which can be closed during winter months) are located at the bottom of the southern façade and allow hot air collected under

the elevated floor to circulate upward through a gap between exterior-mounted, double-paned Low-Emittance (Low-E) glass and the interior-mounted water wall. This flow of air over the water wall cools the individual plastic containers, which, in turn, siphon heat from the interior space. The rising air then continues into a tapering gap (Venturi effect) under the photovoltaic array, thus cooling the underside of the roof panels.

The PV panels are also bi-facial, that is, both sides are able to capture solar rays.

Unabsorbed rays pass through the collector, bounce off the reflective white-painted roof surface, and rebound to the underside of the unit to be utilized by the "backside" of the panel. The air-cooled, bi-facial panels have 35% greater collection efficiency than normal single-sided panels.

In referring to the purpose of the SEED[pod] building envelope, Larry Medlin, AIA, U of A Professor of Architecture and Faculty Principal for the project, notes that it was designed as a selective filter that "permits users to advantageously interact with positive environmental forces." The goal, Professor Medlin further points out, is to create "an understanding and stimulate a sense of responsible stewardship of nature."

For more information, be sure to see www.uasolardecathlon.com. ■

The University of Arizona Solar Decathlon 2009 Team （团队成员）

Faculty Principals: Dale Clifford, Christopher Domin, Matt Gindlesparger, Álvaro Malo, Larry Medlin, Joe Simmons, Jason Vollen.

Student Principals: Eddie Hall, Mike Rageth, Peter Secan, Anton Toth, Sherwood Wang.

Student Team: Adam Strauss, David Adriaanse, Luke Cline, Colleen Cummings, Yasaman Haji Esmaili, Paige Greene, Tyler Jorgenson, Lin Lin, Jared Logue, Joshua Milgram, Kaveh Namazyfard, Chad Nielsen, Brendan Nuriddin, Federico Peralta, Matt Presti, Jen Rios, Gabrielle Sacknoff, John Vawser, Ryan Velasco, Brent Vander Werf, Matt Williams, Weston Wood.