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ADVANCING COMMUNITY DESIGN EDUCATION

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ABSTRACT
In architecture, the main pedagogical challenge lies in the gap between what is and what should be taught in design studios. What is appropriate material for inspiring fledgling architects to move beyond one-off authored architecture, and in what ways can teachers make students more equipped to deal with an environmentally-stressed, resource-constrained, over-populated world? The education of future architects can be transformed through a sustained commitment to more than a single project, client, or place. It is essential to introduce architecture students to core principles addressing community needs and available resources.
The desert is home to one sixth of world's population, as well as occasional strong and violent sand storms. To survive, humans must live in harmony with the environment, and build self-sufficient lives in unison with nature. This research describes the efforts of first- and fourth-year architecture students to improve livability, increase human comfort, expand community design, and enhance humanity's relationship with its surrounding environment by considering the opportunities and constraints imposed by desert regions. In the spring of 2016, architecture students were asked to design a self-shaded and self-ventilated building envelope called a Breathable Wall, and thus make an impact on the social landscape of a community by addressing climatic regulations and working with (instead of against) desert conditions.

Keywords: Self-ventilate, Self-shade, Self-cooling Building Envelope, Breathable Wall, Sustainable and Healthy Living Community, Desert Architecture, Environmental and Social Changes, Design Curriculum.

1 INTRODUCTION
The history of architecture is often a history of unique, one-off buildings and avant-garde structures designed by single superstar architects. Yet while only a very small fraction of the world's built environment is designed by famous architects, most architecture schools adopt the narrow pedagogy of a single project for a single client that is firmly tied to its own site. While useful for illustrating the potential of a socially and economically consequence-free and lavish design proposal, in this context conventional architectural studios become an overlooked opportunity to suggest a more broadly relevant society-based approach. Consequently, students are infrequently shown the potential of continuing a design project as an environmental, social, and cultural practice that extends beyond the completion of a building. Instead, the building's development is left up to students with isolated views and a general disregard for the overall environmental, social, and economic impacts of the project.

2 LEGACY OF THE DESERT
Home to one-sixth of the earth's population, desert dwellers must adapt to intense heat, fierce winds, and wide temperature swings. Deserts comprise one-fifth of the worlds' land area and their harsh conditions threaten the livelihoods of people on every continent. Buildings located in the desert are vulnerable to sand storms and high winds that can often be sudden, complex, and unpredictable.
In the desert, exterior walls are the first line of defence for a building, but similar to our skin, a wall can be more than just a barrier. It can also be environmentally responsive and a means of improving the lives of the building's occupants. Self-cooling and self-shading walls have been used for hundreds of years and are well-integrated into accumulated building practices. Only infrequently has modern architecture pursued the research and development of integrated building systems for desert structures, as a way of addressing a broad range of environmental, technical, spatial, structural, financial, social,

and cultural design variables. In spite of the long tradition of adaptable buildings being constructed in the desert, most contemporary architecture has featured complex mechanical ventilation and air conditioning systems with significant energy demands. The majority of airtight building envelopes in modern buildings are not breathable and do not allow the building to be cooled. In some cases, the occupants of these buildings even suffer from “sick building syndrome.”

3 BEHAVIOURAL ADAPTATION IN THE DESING PROCESS

The need to survive in harmony with the desert’s extremely harsh conditions should inform design decisions from the earliest phases of students’ projects [1]. The environmental behaviour of building envelopes subjected to intense heat and high winds is of great importance to desert survival. To this end, the breathability of a building envelope is essential to its environmental performance. This research introduces an integrated building system called a Breathable Wall (BW) that was developed by architecture students (see Figure 1).

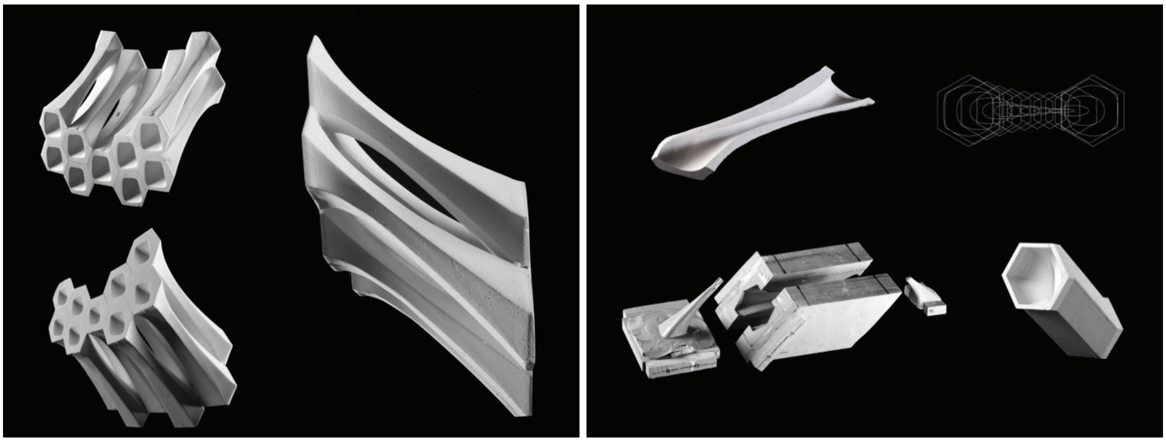

Figure 1. Stackable BW units used to direct airflow into inlets. Designed by Kimberly Lambeth & Linda Reyes

By thinking holistically about an entire building’s envelope system, the Breathable Wall Project (BWP) was able to offer a new perspective on community-oriented design. This project capitalized on the benefits of a long-term nuanced relationship between social and environmental responsibility and the discipline of architecture.

4 THE BREATHABLE WALL PROJECT

In the spring semester of 2016, first- and fourth-year architecture students in colleges of Architecture in the U.S. were asked to think holistically about an entire building envelope system in the desert. As a result, they designed the BWP to be an integrated self-cooling, self-shading, and self-ventilating approach to architecture.

In an intensive four-week design assignment, students created buildings to be located in the heart of the United Arab Emirates, utilizing the proposed wall system and considering the dynamic interactions of wind with buildings over time (see Figure 2). To enhance humanity’s relationship with its surrounding environment, these building designs were based on the concepts of sustainable living, a respect of nature, energy savings, and resource streamlining.

In a desert environment, once a mixture of air and sand touches the outer face of a porous wall, breathability becomes not only about the ability of the wall to allow the indirect passage of air, but also its capability to prevent the transmission of sand [2]. This project provided an opportunity to experiment with various designs for different porous and permeable building skins that would purify the air as building “lungs” when sandstorms occur. In some hot and arid countries, wind towers are already in place that enable natural air to move through different spaces, acting as “lungs” for vernacular buildings.

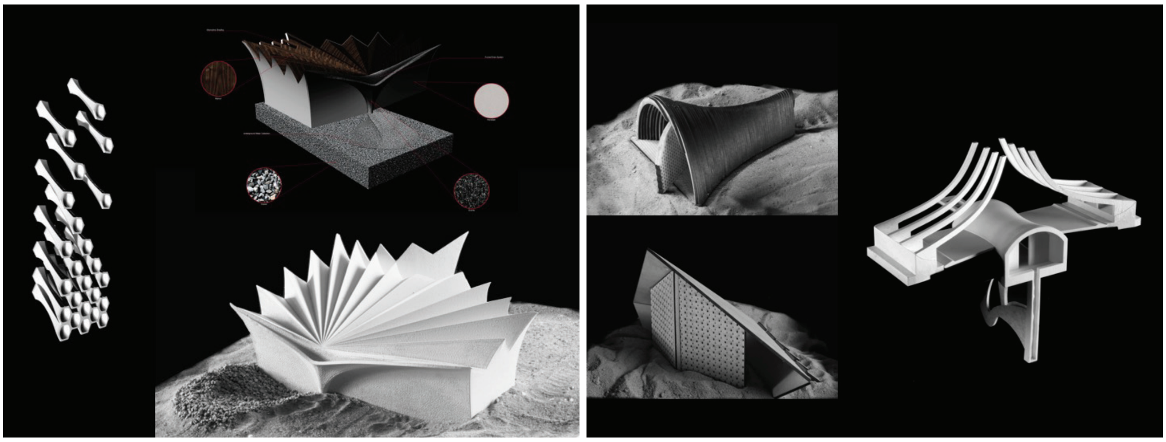

Figure 2. The proposed BW systems were used to design several buildings. Left: Designed by Kimberly Lambeth & Linda Reyes - Right: Designed by Anna Schaper (top)+ Kenneth Gilbert (bottom) + William Palmer (middle)

Here, instead of using a unit equipped with conventional filters to screen out sand, the main question was how the stackable BW units could turn the structure of the building into its own air filter when dusty winds passed through. In general, any wall with many pores is breathable. However, in the BWP, walls could not be made out of very small openings since they had to capture light and pass it to the interior. In this project, openings at the ends of sloped surfaces served as inlets, allowing wind to flow into the building but keeping out sand. Since air moves from high pressure areas to low, the resulting funnel effect was helpful in drawing air through the wall units.

Considering different design strategies within the bounds imposed by the desert allowed students to produce a wide range of possibilities. Armed with empirical knowledge, students assessed their design proposals based on different variables and their likely consequences. After using physical and digital simulations to study the interplay of air and sand in response to the wall, students fine-tuned their placement of inlets and outlets in their proposed wall systems, relative to the positive and negative wind forces acting on the wall structure. Almost every student built a working prototype to test the performance of his or her design.

The wall surface retarded wind flow via friction caused by the angle of the wind incidence and the shape, orientation, and spatial arrangement of the wall [3]. Changing the direction of the air entering the units resulted in the sand flowing out. As the wind blew towards the units, the slopped surfaces captured the sand by creating a drag, which slowed the wind. Since the wind could not carry the heavy sand particles at these lower speeds, the particles were deposited on the slopped surfaces. The result was cleaner air being shunted through the inlet.

The architecture students were asked to sculpt their proposed designs to draw wind into the inner part, providing free cooling and fresh air. The result was simpler, more robust, less energy-consumptive systems. The students oriented their proposed designs to take advantage of prevailing winds, to improve energy performance and enhance occupant comfort. Simple technology allowed inhabitants to control the level of airflow and pressure.

A natural ventilation concept was integrated into the students' design proposals. Besides the form of the building envelop, the use of natural ventilation, its consequences as well as its possibilities, informed their layout and organization of the interior space.

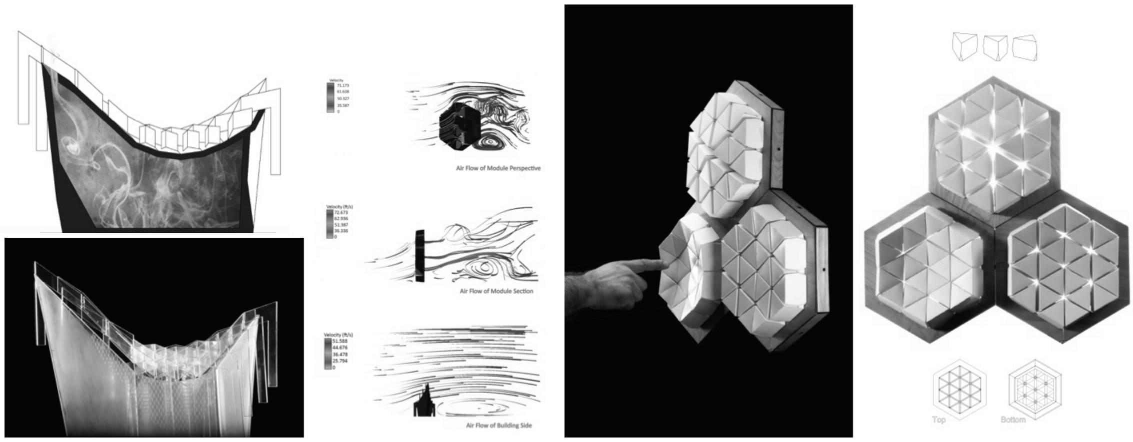

Figure 3. Some of the projects were not passively static in their interactions with wind. Designed by Ashlyn Wilt & Esteban Armenta

In general, the proposed BWs provided the opportunity to:

- Draw in air from outside the building,
- Slow down incoming air,
- Filter out sand particles,
- Purify entering air,
- Direct clean air to the interior and circulate it through the building,
- Cool the building,
- Remove exhaust air from the building,
- Become self-sufficient on renewable energy, and
- Build an ecologically healthy building to empower the community.

The BWs were designed to enable the building to respond to the desert's extreme heat during summer. Although the exterior walls might attract a great deal of heat, it was likely that less energy and effort would be spent cooling the interior. In general, by incorporating a BW system, the building skins could make a significant impact on the building's use of mechanical systems and the related energy consumption. When not being mechanically cooled, the interior temperature could be regulated by proper ventilation.

5 TOWARD A HEALTHY LIVING ENVIRONMENT AND SUSTAINABLE COMMUNITY

The authors believe that there is a profound link between indoor environmental quality and sustainable communities. Improving air quality helps people live healthy lives. The breathability of a building offers the potential for a healthy indoor environment, especially for people with an elevated risk of health problems. Therefore, the BWP could help future architects to create healthier communities.

As an electricity-free means of removing fine and coarse particulates from the air, a BW system reduces the types of indoor air pollution that affect occupants' health and wellbeing; such systems will be especially useful in domestic dwellings in developing countries, especially if occupants have respiratory ailments such as dust allergies [4]. The BW units, as the main elements of mitigation and wind control, were designed to offer strong performance and a positive aesthetic appearance, satisfying both physical and mental health needs. Some proposed projects were not passively static in their interaction with dynamic wind (see Figure 3).

6 FROM MICROCLIMATE MODIFIER TO THE COMMUNITY AT LARGE

In the BWP, it was important for students not to lend themselves directly to a determined form. In the studio, environmental aspects were briefly reviewed to assess how such issues might manifest themselves in proposed BW systems. Then, by adding the social and economic conditions of desert living to their proposed designs, students attempted to combine functional performance with practical needs and esthetic consequences. Bringing together disparate variables into one cohesive project encouraged students to look at community-based design in all of its complexity, rather than simply seek a single yield.

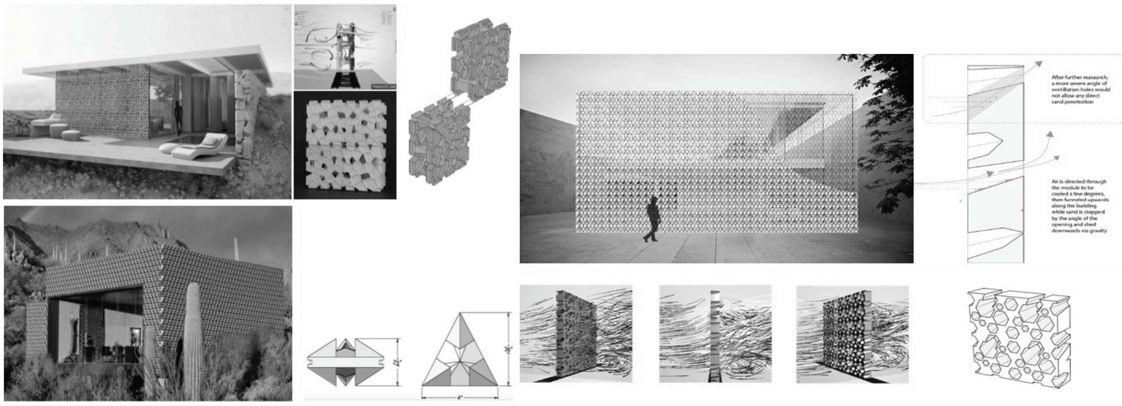

Figure 4. BW units raise occupants' comfort level and empower the community. Left (top): Designed by Kristin Higgins - Left (bottom): Designed by Deborah Madera - Right: Designed by Sydney Ritter

By identifying the major environmental aspects that contribute most to community betterment, the BWP instilled in students a set of environmental values that will lead to social and economic change. Students emerged with a newfound motivation to use environmental resources within reasonable ecological limits and regulate the major forces acting on their proposed buildings, employing the sun and wind to facilitate human thermal comfort rather than costly mechanical systems. This bottom-up process resulted in designs based on sustainable built environments in harmony with nature and the occupants, initiating social empowerment.

Complementary to its environmental impact, the BWP sharpened students' perceptions and their ability to go beyond the local level of "microclimate modifier" to society as a whole (see Figure 4). Students' designs were immersed within the context of building a community culture in which the needs of desert-dwelling people and the development of technological opportunities were carefully taken into account. To this end, the BWs were considered potential agents of environmental and social change in desert communities.

Compared to other architecture studios, the BWP was not a vehicle for exploring design for its own sake. By underlining the mutual interactions of the BWP's technical, social, and economic impacts, the design process placed additional emphasis on the acquisition of a socio-ecological knowledge foundation essential to sustainable design education in architecture.

7 CONCLUSION

As discussed above, in most architecture design studios, a focus on the significance of a single project for a single client often results in a lack of consideration of deep-rooted community-based designs on a broad scale. In order for environmental and social dynamics to become a priority and receive proper educational support, the Breathable Wall Project established a pathway for architecture students to journey beyond designing buildings to fit the dimensions of a single site, for a single client. Embedding micro-scale wind flow and macro-scale wind movement into the design process allowed this project to improve students' understanding of the complex connection between the environment and society. In the end, this was not just a part of the studio curriculum, it provided an essential foundation for architecture students seeking to be environmentally educated, socially aware, and community conscious, as their profession and their world now demands.

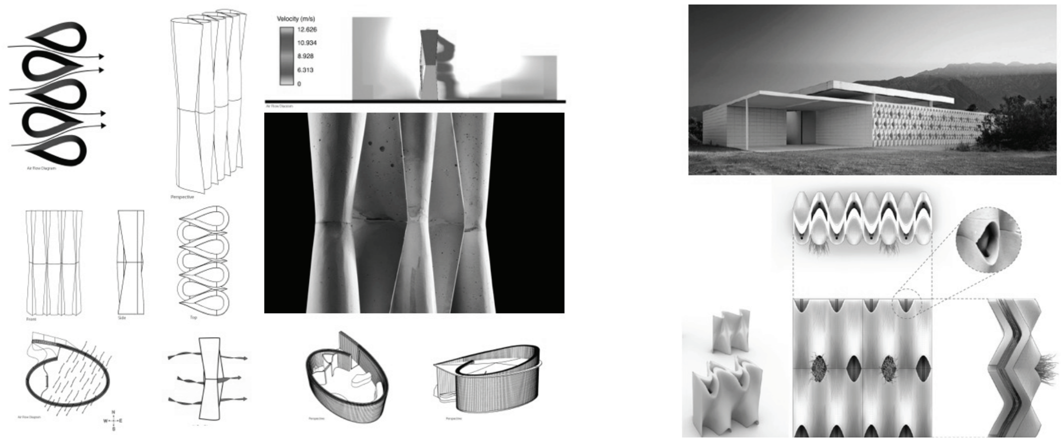

Figure 5. Transitioning from the formal approach to climate-related aspects of architecture as a means of addressing ecological community development. Left: Designed by Brady Preiss & Bryan Smith - Right: Designed by Garrett Callen

This project provided a platform for a wide variety of design solutions within given limits. The Breathable Wall Project reinforced students' motivation by allowing them to feel that their learning was relevant to real-life challenges. Their focus was desert sand storms and the genuine threat to desert dwellers' survival. A basic premise of this paper is the notion that designing better buildings will improve quality of life for all who inhabit them (see Figure 5). Thus, this project was a step towards impacting human life and raising the standard of living in desert regions.

Since choice of design and method in desert buildings have a significant effect on the people who dwell in them, the Breathable Wall Project hoped to increase a building's capacity to adapt to its natural environment, social structures, and overall human activity, as well as expedite the general incorporation of environmental and social measures into design studios. The project's many virtues, including supporting a healthier interior environment and encouraging low-energy ventilation methods, lend themselves to strengthening our society such that it can become more ecologically sustainable, and thus improve human well-being.

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