Visualizing Performance: Research Based School Design in Mazar-i-Sharif, Afghanistan

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ABSTRACT: This paper presents research conducted by graduate architecture students participating in the design of a school in Mazar-i-Sharif, located in northwest Afghanistan. During the course of a ten-week studio, students developed recommendations for improving the Afghan Ministry of Education standard school design. Achieving a higher level of performance for these institutions would enhance the overall student experience and potentially increase enrollment capacity. This paper sheds light on the benefits and advantages of architectural research and design in an area of development where architects typically do not participate. This project also demonstrates the influence data can have on the design process, and illustrates how students can visually communicate complex information resulting from research to others.

KEYWORDS: Afghanistan, Pedagogy, School Design, Development

INTRODUCTION

Major cities in Afghanistan have experienced unprecedented population growth in the past ten years due to the return of refugees, soaring birthrates, and the migration of people from the countryside to urban areas. The population is increasingly dominated by youth, with almost half under the age of 14. (UNdata, 2009) Of this group, only 50% are currently enrolled in school, with a still smaller percentage represented by female students. (UNdata, 2009) However, by 2020, the Afghan Ministry of Education plans for basic education enrollment to increase to 104% for boys and to 103% for girls. (Ministry of Education, 2012) The demand for schools is high in Afghanistan, causing overcrowding, and the necessity to operate on a shift schedule in order to increase enrollment. This problem is further exacerbated by the practice of closing schools during the coldest part of the year, in response to a lack of funds for fuel and poorly insulated classrooms.

Several international aid organizations are working with the Afghan Ministry of Education (MoE) to build schools around the country, and while many of these projects follow the standardized construction documents provided by the government, the actual performance and construction of these schools leaves much room for improvement. (Faureau, Jarny, & Dezuari, 2010) The standardization of details and form attempt to impose a uniformity of product, and mitigate life-safety hazards, but the school typology does not require a response to issues such as orientation, climate, or local needs.

Figure 1: Typical Afghan Ministry of Education school.
Source: (Ayni Education International 2011)

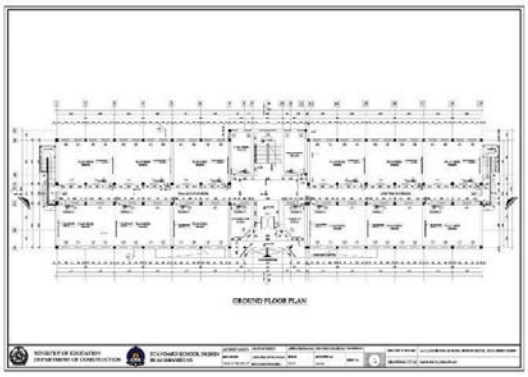

Figure 2: Afghan Ministry of Education school plan.
Source: (: Afghan Ministry of Education 2012)

In short, the schools meet some very basic requirements, while others are not considered. Despite its shortcomings, the standardized school typology in Afghanistan has been an important tool for facilitating school construction across the country in recent years, and will most likely be the primary model used for future educational infrastructure. (Fig.1 and 2)

This paper sheds light on the benefits and advantages of architectural research and design in an area of development where architects typically do not participate. Moving beyond the bare necessity of providing a roof over students' heads is a challenge, but even small improvements to construction and minor adjustments to local conditions would allow MoE standard schools to better serve students and the communities where they are located. With the goal of designing comfortable, flexible, and culturally connected schools, the overall quality of the student experience can be improved, and also allow for a planned increase in enrollment. It is a critical time for Afghanistan's youth, and every opportunity for positive change should be capitalized on, especially within the education system.

I. PROJECT DESCRIPTION AND METHODS

I.I Project Description

The research outlined in this paper uses the standard MoE school as a point of departure for new school designs featuring critical improvements. Architecture students at the University of Washington–using an actual school project as a subject of design research–have devised new strategies for improving the performance of the soon-to-be constructed Gohar Khaton Girls' School in Mazar-i-Sharif, Afghanistan. Seventeen graduate students participated in the "Afghan Studio" during the ten-week autumn quarter of 2012. While the work presented here is theoretical, there have been several opportunities for the student designs to influence decisions made by project stakeholders involved in the design and construction of the actual school. Beyond the actual project, the process of designing a girls' school in Afghanistan has benefited all of the parties involved, and the dialog initiated during the course of the studio continues well past the end of the quarter. This project was made possible by the collaboration between the department of Architecture at University of Washington, the Afghan architect Salim Rafik based in Kabul, Ayni Education International (Ayni)–a Seattle based aid organization committed to building schools for women in Afghanistan–and architect Robert Hull, from the Miller Hull Partnership. This unique partnership between an aid organization, practice, and academia, was conceived as a strategy for leveraging improvements to the MoE standard school plans. This project asserts that design can play an important role in the everyday life of people in developing countries, and that it should not remain solely in the domain of wealthily investors–as is often the case in contemporary Afghanistan. In addition, Ayni's mission, to "build bridges of understanding and mutual respect between Afghans and US Americans," was also furthered by the studio project. (Ayni Education International, 2012) Issues of gender equality, war, religion, and occupation were as much a part of the studio dialog as the pragmatic requirements of thermal comfort and budget, and brought the students to the heart of global realities in an immediate way. Achieving a balance, between technical and cultural demands, was key to the studio's success.

I.2 Studio Research Methodology

Gohar Khaton Girls' school is located in the center Mazar-i-Sharif, Afghanistan's fourth largest city. Not far from country's most famous and holy shrine of Hazrat Ali, the school is tucked at the end of a dead-end street, in a courtyard next to the Balkh Ministry of Education. The existing school is currently in a state of disrepair, and long overdue for major renovation and maintenance. (Fig. 3)

Figure 3: Existing Gohar Khaton Girls' School in Mazar-i-Sharif. Source: (Ayni Education International 2012)

For this reason, and its prominent position next to the Ministry of Education, government officials gave Ayni special permission to construct a new school on the site that departs from the MoE standard plans, with the goal of creating a showcase for the Balkh Ministry of Education.

In order to create schools that are viable and accepted institutions, Ayni places great emphasis on building ties with community leaders, and their schools are only constructed where the organization is invited. After its construction, the Gohar Khaton School will be run by the Afghan government, and integrated into the existing education system. The complex is to provide classrooms for K-12 classes, serving at least 3,500 students or more a day. To achieve such a high enrollment, the school will be used on a rotation basis, with groups of students coming to class at different times throughout the day. The population in the city is growing rapidly, creating an urgent need for education facilities. It is expected that the enrollment will grow well beyond the expected 3,500, and the school must be designed to accommodate this rapid expansion. The students attending the school will come from all ethnic backgrounds found in the region: Tajik, Pashtun, Uzbek, Hazara, Turkman, Arab, and Baluch. Because girls are typically not allowed to walk very far from home, most will be coming to school from nearby neighborhoods.

Many schools in Afghanistan are connected to either a limited, unstable power supply. In addition, schools typically operate on little or no budget, leaving no funds for heating fuel. The project in Mazar-i-Sharif is no exception, and demands that the school be designed to operate essentially off-the-grid. High-tech equipment, such as photovoltaics, are not economically feasible for most schools in Afghanistan, and are also difficult to maintain in such a harsh environment. The architect Salim Rafik was commissioned by Ayni to design the school, which is slated for construction in 2014. Concurrently, students at the University of Washington were given the same site and program as a theoretical studio project. It was clear from the outset that the architect's computing capacity would be limited, and because of this, he was open to having access to various master plan options and building form studies informed by environmental performance analysis–something the students could easily generate. Balancing daylighting with solar gain became an important focus of the studio research, and is a critical factor in any serious proposal for improving the MoE schools. As I will further elaborate on in the next section, the data from programs such as Ecotect and Radiance influenced design decisions, from material choices to opening placement and sizes. Here, quantitative data generated by the students in the studio had a direct influence on qualitative design decisions.

In addition to thermal performance and daylighting, the students also identified school expansion, community outreach, and material cost and availability as areas demanding more focused research. Because it was not possible for the students to visit the site due to security risks, site data was gathered through multiple methods. Information about construction materials, for example, originated from literature provided by the French NGO, Groupe Energies Renouvelables, Environnement et Solidarités (GERES), and information relayed to the students by the local contractor involved in the school construction. Information about the school community came from mapping surrounding neighborhoods, a field site visit and interviews conducted by studio instructor Robert Hull, and Ayni Education International's board members. A literature review of sources covering Afghan culture was also completed, which included books by Afghan anthropologists such Thomas Barfield and writings by Nancy Dupree. Because women's issues in Afghanistan are particularly challenging for Westerners to grasp, the students also read several essays from *Land of the Unconquerable: the Lives of Contemporary Afghan Women*, a book examining the realities of life for women in both rural and urban Afghanistan. Two of the most important documentations of traditional Afghan architecture, *Afghanistan: An Atlas of Indigenous Domestic Architecture,* and *Traditional Architecture of Afghanistan* were also invaluable resources for the studio work. These books are currently the only comprehensive source for studying traditional Afghan architecture. In addition to literature resources, we were also fortunate to have Robert Hull on the studio team. Hull was involved in the design and construction of over 40 schools while in Afghanistan during the 1970's as a member of the Peace Corps. Students also consulted with Abdul Chahim, an Afghan structural engineer involved in several school construction projects in Afghanistan. The architect Salim Rafik proved to be an effective consultant as well, and was able to critique the student proposals midway through the project. All of these resources influenced the student design work, with some aspects of research having more visible influence than others.

The project required consulting a broad spectrum of sources, spanning from the cultural to the pragmatic. Examples in the next section will illustrate how the students began the design process by searching for very tangible data, from the cost of building materials to the amount of pupils that could humanely fit into a classroom. The students soon discovered that just below the surface of numbers and facts, lay cultural and political connections, influences, and implications of a broader order. Research into building material availability in Afghanistan, for example, will soon bring one to matters of corruption, scarcity, and environmental degradation. A study of class size tells the story of population growth, the urgency to educate

the masses, and the unbearable conditions that young people are willing to suffer in order to receive a few hours of instruction each day. With the ultimate goal of devising ways for improving the MoE schools, the students soon found themselves making decisions requiring careful consideration against the backdrop of a politically and culturally loaded milieu. In moving from the research phase into the design phase, a process of critical inquiry was initiated by the students, which brought many important questions to the fore. The pursuit of these questions would continue to shape the work throughout the duration of the studio, and would also influence discussions between the students and the other project stakeholders.

2. "VISIBLE RESEARCH" IN STUDIO

2.1 Graphic Catalysts for Dialog

"The purpose of evidence presentation is to assist thinking." Edward Tufte (2006)
Visual communication of research information became an important part of the studio in several ways. The project structure required that the students communicate their research findings to non-architects, namely to the board members of Ayni. Much of the initial research, compiled by the students and presented to Ayni for review, became a catalyst for discussions with the board members and brought attention to issues that they had not considered when building schools previously.

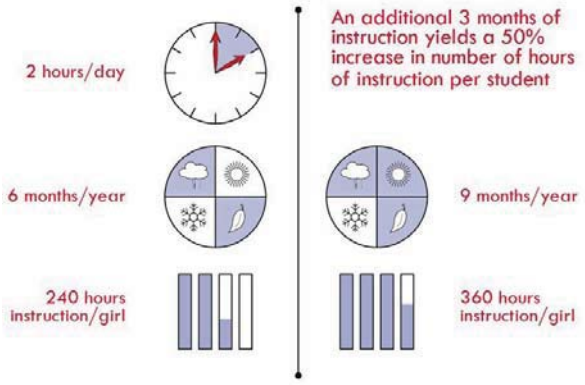

Figure 4: Better thermal performance increases instruction hours.
Source: (Garland 2012)

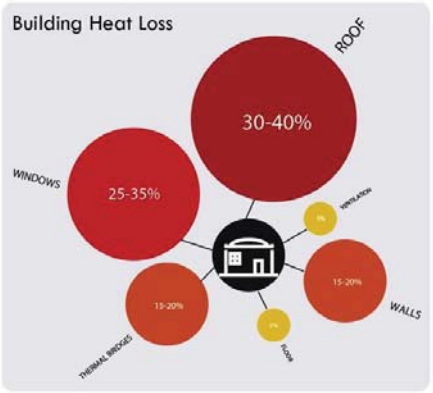

Figure 5: Areas of heat loss.
Source: (Esmaili 2012, Faureau, Jamy, & Dezuari, 2010)

The students' graphic representation of information also raised important questions about the actual school and its execution, and became the basis for more detailed research during the design phase. One of the main topics of discussion at the outset of the project was how to improve thermal comfort, particularly in winter. Increasing thermal performance would provide a better learning environment, and permit the school to remain open during the coldest months of the year. This, in turn, would allow for increased enrollment, more instruction hours, or the use of the school for other purposes during the times it typically would have been closed. Figure 4 was used to communicate this possibility to Ayni. Strategies for increasing the thermal performance of the school were considered by the students, such as insulating the building (many MoE schools are not insulated), the use of thermal mass, and building orientation. Adding insulation was the only option that would increase construction costs, and would require further discussion with all of the project stakeholders. The potential of either increasing enrollment or instruction hours was an exciting possibility for the aid organization, and investing in insulation appeared to be a viable option, though it was determined difficult and expensive to insulate the walls. Using figure 5, the students demonstrated to Ayni which parts of the building would be most prone to heat loss. This diagram began an important conversation with the board members about where best to invest money for insulating the school. It was recommended that at minimum, the roof should be insulated, and less expensive measures would need to be taken in order to compensate for heat loss in other areas.

In addition to facilitating discussions about how best to improve comfort and increase enrollment, figure 6 illustrates how the students represented given project data in a form that highlights conditions requiring further investigation and research. With this diagram, the students presented the actual school budget in graphic form. The students and Ayni were surprised by the amount of money spent on furniture, finishes and equipment. This graphic began a more detailed investigation into the causes of the higher expense, and it was found that one of the most expensive items in the budget were the standard school desks imported from

China. The students proposed ideas for fabricating the desks locally, and also brainstormed with the Ayni board members about other possibilities for reducing the FF&E costs without sacrificing quality.

These are just a few examples of how the students used the visual representation of data to communicate, question, and ultimately to begin a dialog with Ayni about the critical issues facing the school project. As the quarter progressed, the students continued to consider how best to present their design work to the Ayni board members in ways that were accessible and understandable.

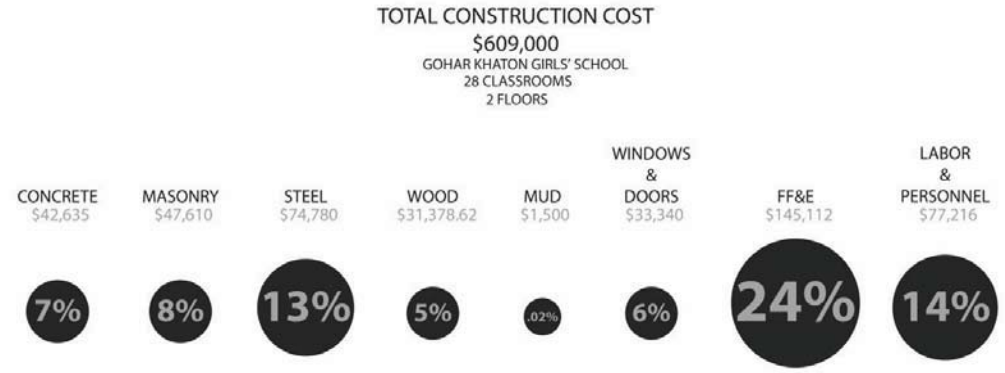

Figure 6: Graphic representation of the school construction budget.
Source: (Esmaili 2012)

2.2 Visual Decision Making Tools

Apart from communicating important research information to others, the students also used visual representation as a tool for making design decisions. Figure 7, for example, convincingly illustrates information about a fact that was already common knowledge for the students in the studio–most industrially produced building materials are imported into the country. The graphic representation added power to the facts the students already knew, making abstract material flows more tangible.

Figure 7: Map of imported building materials.
Source: (Esmaili 2012)

This map's influence was to be felt for the duration of the project, and played a crucial role in the students' decision to minimize the use of imported goods such as cement and steel, and to investigate other options closer to the construction site. The students discovered that local labor and materials could have many positive benefits for MoE school projects, from stimulating the local economy, to decreasing construction costs, and reducing transport induced CO2 emissions. The map was the starting point for many of the studio projects, leading to different outcomes, which I will now describe in further detail.

2.3 Research in the Student Design Process

Student team A began the project by studying the possibilities of using locally produced brick for their school design. Fired brick is a common material in Afghanistan and has a long tradition of use in the country, but has fallen out of favor as concrete has become more prevalent in contemporary construction. While exploring the advantages that traditional Persian brick patterns could offer their project, the students were struck by the idea that the material could accomplish several functions simultaneously. Using masonry would not only support local industry and labor and give the school its character, it could also act as a shading and screening device, thermal mass, and it could serve as the vertical load-bearing structure if designed correctly. The goal to maximize the performance of brick in the school set the parameters for the duration of the project research for team A.

Using a combination of sketches and digital simulation, the students studied how different masonry patterns and their percentage of openness affected the light entering the classroom. Several of these studies were generated in order to achieve the desired lighting conditions in the classrooms year-round while insuring shading during the summer months.

Figure 8: Initial sketch of masonry screens. Source: (Esmaili and Kamara 2012)

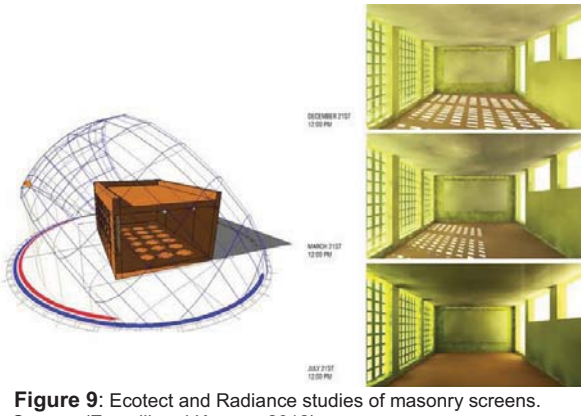

Figure 9: Ecotect and Radiance studies of masonry screens. Source: (Esmaili and Kamara 2012)

These studies also took structural stability and the required percentage of thermal mass into consideration. Throughout the design process, team A used the graphic side-by-side comparisons of their lighting simulations and sketches to make informed decisions about their project. (Fig. 8 and 9) Because the students were working in teams, the graphic output from the analysis became an effective way to reach a group consensus, by allowing for a quick assessment of options. Using software such as Radiance to optimize traditional masonry patterns is an interesting undertaking, and points to possibilities for future study. Although it was not within the scope of this project, the research could be taken further by using Rhino/Grasshopper and Diva to study an even greater number of masonry configurations.

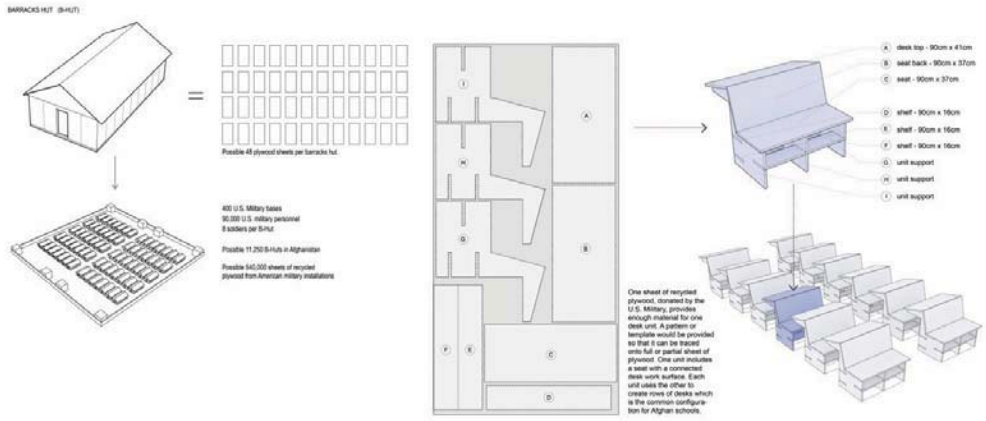

Figure 10: School desks made from dismantled NATO barracks. Source: (Thies 2012)

While researching potential sources of materials for the school, Team B discovered an unlikely source, NATO bases. In the initial scenario proposed by the students, salvaged wood from four hundred soon-to-be decommissioned barracks would be used for constructing school desks. Figure 10 was used to communicate how this might be accomplished. This idea was so compelling that it inspired one of Ayni's board members to take the proposal to a military contact in Afghanistan. The student research unveiled an enormous source of wood that had been imported into a country currently suffering from mass deforestation. Although it was not calculated, we can probably assume that there is more wood available in NATO bases than in all of what remains of Afghanistan's forests. This initial idea was expanded during the development of team B's project, where the salvaged NATO wood was employed to form "sunspaces" for the school. The project combines what is essentially a US American construction system with the MoE standard design for a masonry school. The lightness of the wood permits maximum solar heat gain in winter, and the thermal storage capacity of masonry holds warmth and coolth–reducing daily temperature swings in the building.

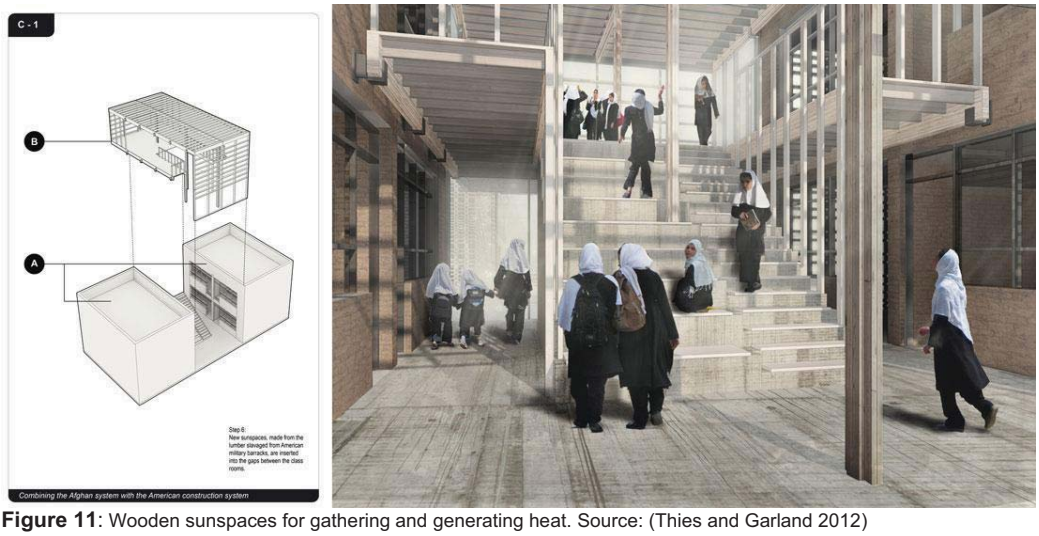

Figure 11: Wooden sunspaces for gathering and generating heat. Source: (Thies and Garland 2012)

The sunspaces also bring added value to the school curriculum by offering larger, covered areas for gathering and space for much needed vocational training. (Fig. 11) This solution is pragmatic, while offering a subtle critique of the NATO occupation.

One of the most important, and evocative visual tools used by the students were the rendered perspectives. In a sense, the perspective in figure 11 is the culmination team B's project research, with the power to convince or to the possibility to dissuade. Team C's project further illustrates this point.

Figure 12: Optimized Afghan vaults create pleasant, daylit classrooms. Source: (Lang and Crofoot 2012)

Initial research of traditional Afghan vault systems was informed by Ecotect lighting analysis, and a new vault typology was developed that evenly distributes daylight in the space. Final simulations using Radiance were used as the basis for interior classroom perspectives. (Fig. 12) The classroom perspectives were of

particular importance to those reviewing the student projects, as they reveal the quality of the space, and were the final benchmark used to judge the success of the projects. Creating renderings that simulate important aspects of reality such as daylight, while retaining an element of abstraction, was critical for the project representations. The renderings have also become an effective vehicle for increasing the project's public visibility, making it very accessible to a general audience. This is an important aspect to consider, as the renderings bring attention to significant issues not often in the public eye in the US.

CONCLUSION

The research generated by the students in the studio did ascertain several options for improving the MoE standard schools, from optimizing systems utilizing local building materials to improving daylighting and thermal performance. There were other recommendations generated by the studio not mentioned here–discussing these would be beyond the scope of this paper. It is important to reiterate that the student work was purely theoretical, and was only intended as a recommendation. It is up to Ayni, the architect, and the local community to decide what will work best in the field. The student design research points to areas requiring further study, and it also provides glimpses of what the MoE school designs could look like if they were allowed to adjust and adapt to their local context. The students did initiate important discussions about critical issues, and brought attention to areas that have been previously been overlooked. How these recommendations influence the final design of the school remains to be seen. The Ministry of Education is permitting a bespoke design to be built in this instance, but whether the political will exists to make more substantial policy changes in the future is unclear.

The student work changed the thinking of the Ayni board members, but designing in a real-world scenario also benefitted the students. Working with an aid organization demanded that the students adopt a new means of discourse. Using the graphic representation of research findings became a useful tool for communicating with non-architects, as well as an excellent method for making team design decisions. In order to develop improvements for MoE schools, the students had to acquire a detailed understanding of the local context as defined by cultural, social, environmental, and market influences. The lessons of designing in Afghanistan extend well beyond the parameters of thermal comfort and structural stability. In their endeavor to create appropriate school designs, the students grappled with the development of an optimized technology that achieves a careful balance between technical analysis and cultural expression. As the late Egyptian architect Hassan Fathy observed, "Science can be applied to various aspects of our work, while it is at the same time subordinated to philosophy, faith and spirituality." Designing a girls' school in Afghanistan became a catalyst for studying the conditions of traditional and contemporary culture in the country, opening the students' minds to circumstances beyond the scope of a typical studio.

Afghanistan has a long history of instability, strife, and war–today's headlines do not report a better fate as NATO troops begin to withdraw from the country. As of this writing, we are hopeful that the new Gohar Khaton School will be built, bringing change to the lives of many young women in Mazar-i-Sharif. Ayni Education International estimates that for every girl educated in their schools, seven to eleven family members are also positively affected. (Ayni 2012) A single school can touch the lives of many people, and design can play a major role in improving that day-to-day experience. We hope the new Gohar Khaton School will set a positive precedent for future schools built in Afghanistan.

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