Learning from Limitations: Design and Construction of a Rammed-Earth Community Kitchen

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Abstract

This paper explores how a spontaneous design-build project—a low-cost rammed-earth community kitchen—offered students valuable hands-on learning opportunities. Developed and built over four months on a semi-remote site, the project addressed challenges such as limited resources, communication with Deaf client-collaborators, and student training of non-specialist community volunteers. In this project we encouraged students to challenge conventional methods of architectural representation through alternative drawing techniques; use conversational, rather than technical, language in communication with collaborators and volunteers; and to develop an openness to real-time problem-solving skills in the field. This project demonstrates how limitations-driven design can provide sustainable and inclusive construction experiences while offering architecture students meaningful, practical engagement.

Introduction

While many architecture schools want to emphasize the importance of hands-on learning, establishing formal design-build programs remains a significant challenge. The hurdles—securing property, managing project logistics, minimizing liabilities, and addressing potential environmental impacts—often result in limited opportunities for students to gain practical building experience.

This paper examines how small-scale, resource-conscious projects can fill that gap. Using the example of a faculty-led design-build project—a low-cost rammed-earth outdoor community kitchen—we explore how constraints can be transformed into teaching opportunities. Over four months, the team, composed of faculty and students, navigated many unique challenges, including building at a semi-remote site with limited material and financial resources, a compressed timeline, collaboration with Deaf client-collaborators, and training community volunteers with no prior construction experience. Adapting to these parameters required real-time problem-solving and highlights the pedagogical value of embracing limitations-driven design.

This case demonstrates that even small-scale spontaneous building projects can provide sustainable and inclusive construction experiences while offering architecture students meaningful, practical engagement.

Project Background

The opportunity for this open-air community kitchen came from an impromptu conversation with Deaf New Americans Advocacy Inc. (DNA), an American nonprofit organization located in Central New York, led by a group of Deaf resettled refugees. The organization offers education, promotes livelihood, and advocates for barrier-free futures with local Deaf communities. As part of their advocacy and livelihood initiatives, the organization launched a community farm called Asha Laaya, or “Farm of Hope”. The farm provides a safe space for Deaf immigrants to share skills and celebrate knowledge from their home countries by growing and selling fresh produce that is culturally familiar. As this Farm of Hope flourished, its need for an outdoor kitchen emerged—a place where working farmers could prepare daily meals, where other local residents could take cooking classes to learn about Nepalese and Burmese cooking, and where stories could be shared over the warmth of freshly cooked cultural dishes. This open-air kitchen would also make room for the Nepalese farmers to continue their tradition of cooking in a “chulo”—an earthen hearth commonly used in Nepal.

We saw this as an exciting project proposal that came with a lot of challenges: we were able to put together only a modest budget of $7,000; the farm was located on a semi-remote site without electricity; we wanted to emphasize the importance of sourcing affordable, environmentally friendly materials; and it was critical to integrate inclusive design and construction processes with DNA community members and accessibility advocates. We saw each of these obstacles as valuable learning opportunities, and decided to use this project to create a design-build experience for our students.

We completed the project in September 2024 and celebrated with a warm meal cooked in the chulo and shared together under the roof (Image 1). As we watched our collaborators adorn the blue community kitchen with golden calendulas freshly picked from their farm, we reflected on the many limitations, challenges, and barriers we had encountered along the way. These parameters prompted us to rethink our approach to design-build education and collective practice, expand methods of design representation, and communication to foster greater community access to inclusive, thoughtful architecture. Through this process, students gained hands-on knowledge far beyond what could be taught in a classroom.

Image 1. Celebration at Community Kitchen on opening day.

Learning Objectives Beyond Building

1. Communicating Effectively

As we set out to design the community kitchen, we recognized that the project would involve not only designing the kitchen and pavilion structures, but also teaching our students the importance of clear communication with our various collaborators. We challenged our students to rethink architectural representation as an adaptable visual tool that can be used to convey design concepts to our Deaf collaborators, and teach construction processes to community volunteers with no prior experience to create an inclusive construction site.

First we needed to establish a clear method of communication with our team of Deaf collaborators. As we learned, within the Deaf community of Nepal alone, there are at least five different dialects of sign language. As a result, even when communicating through one of DNA’s dedicated volunteer American Sign Language (ASL) interpreters, communication with DNA members often took the form of a silent game of “telephone.” Our words would first be translated into ASL, and then into one or more other sign languages, then back to ASL, and finally back to spoken English. This process not only slowed communication, but also increased the potential for misinterpretations. Through the course of repeated translation, subtle nuances could be inadvertently altered, especially when specific words and phrases did not exist across different languages, and conversations could easily derail as interpreters struggled to catch up with dialogue carried out in languages that were not ASL.

As the project progressed, we discovered that clear visual and pictorial communication— colloquial drawings rather than specialized construction documentation— was often the most effective way to bypass the silent "telephone" lines and convey ideas directly to everyone on site. Therefore, we developed a nonverbal instruction manual that communicated the construction process using step-by-step, literal graphic- and gesture-based drawings (Image 2). The intuitive nature of these signs and gestures, together with their repeated use, helped everyone pick up the words quickly and allowed necessary communication to proceed much smoother during construction. These simple, straightforward visuals significantly reduced our need for verbal descriptions and translations, enabling real-time conversations about design ideas between Deaf and hearing team members alike.

As we expanded our architectural and construction representation to foster inclusive communication, we realized it was equally important to teach students to communicate with the other audience involved in the project: our non-specialist volunteers. We encouraged architecture students to take on leadership roles

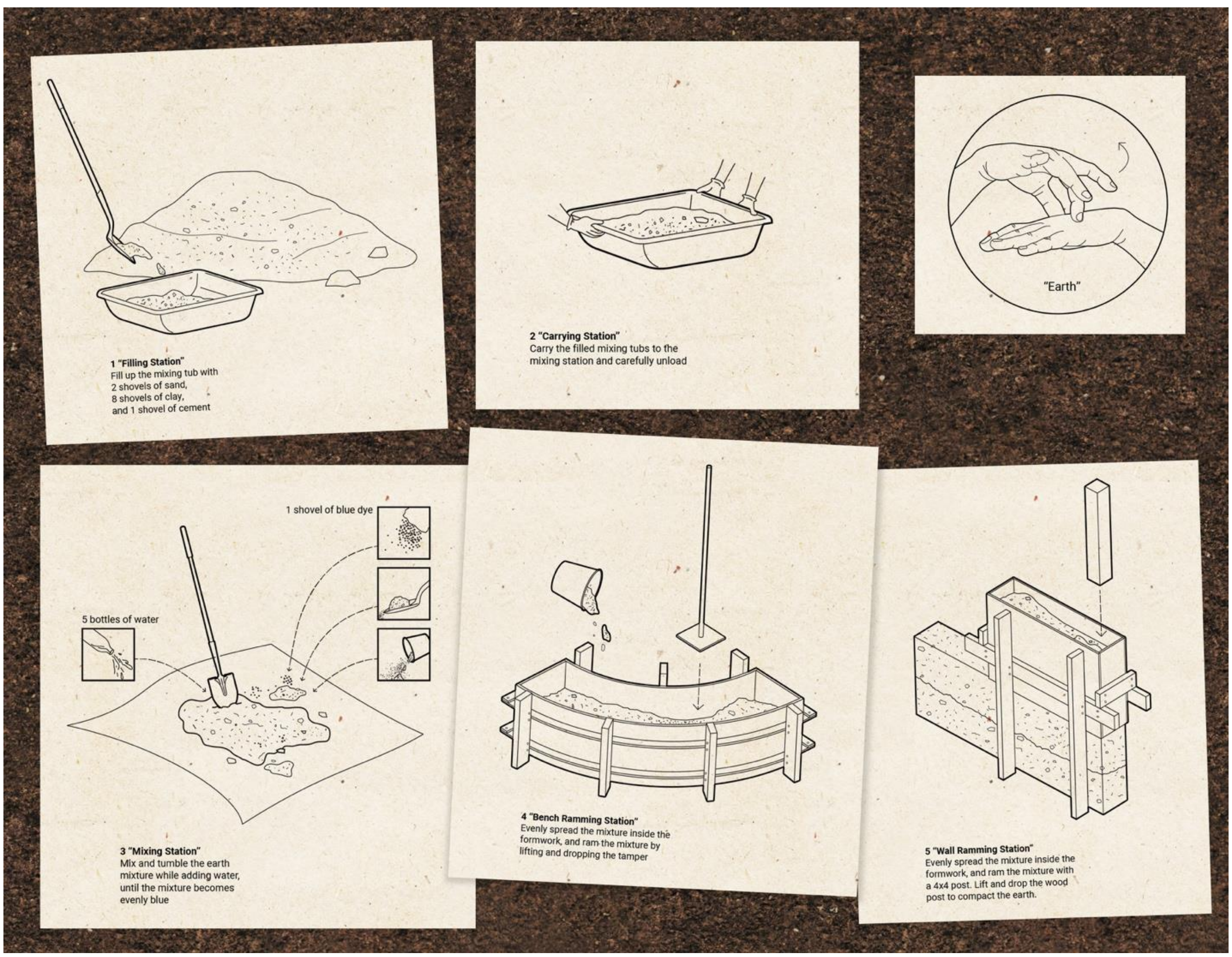

Image 2. Step-by-step instructional drawings.

whenever a new volunteer joined and teach them how to perform each task. We emphasized the use of conversational, rather than technical, language and suggested the students use action-oriented, sensory-based descriptions. When instructing volunteers to create soil mixtures, we referred to ratios rather than specifying different amounts by weight—for instance, “seven shovels of red clay, three shovels of brown sand, and one shovel of Portland cement.” When adding water to the soil mixtures, we instructed them to aim for the consistency of Play-Doh or cow manure, enabling volunteers with different life experiences to visualize and/or feel the ideal texture while fostering a fun, engaging construction environment.[2] This tactile and visual approach encouraged a more intuitive, hands-on workflow; volunteers often recited the instructions aloud as they performed the tasks, their enthusiasm growing as they repeated the process. Including descriptions of how materials look, feel, and even smell, helped empower participants, giving them the confidence and agency to contribute meaningfully to the construction process.

During our lunch breaks, students often discussed better ways to explain the construction processes to other volunteers who do not share a background in architecture or construction. They reflected on their habitual use of architectural jargon and their reliance on technical drawings. In representation classes, we often emphasize the importance of using drawings to communicate our concepts to clients and contractors, often taking for granted that they will easily comprehend architectural details. Direct communication with our collaborators from DNA and community volunteers served as a real-life example to students of the limitations of architectural representation as a means to communicate and connect with a non-architectural audience.

2. Adapting to Challenges On-site

Our emphasis on learning from limitations naturally extended to our material studies, assembly details, and on-site construction methods. We challenged our students to be open-minded and flexible when facing unexpected challenges, rather than holding fervently to their original design drawings. This emphasis on real-time decision making reinforced the notion that construction is not the conclusion of the design process, but an extension of it.

We developed each element of our design proposal with the many limitations of working on a semi-remote site in mind. Familiar, readily available materials—local soils and dimensional lumber—detailed with an ethos of simplicity was a must. Despite our careful planning, many design decisions had to be made on the fly while in the field. The students quickly learned to appreciate that obstacles are to be expected, and remaining dexterous in response to unexpected setbacks can result in positive developments.

Rammed-Earth Walls and Benches

The core components of the kitchen are made with rammed-earth, which not only works well with the Nepali chulo—the earthen stove—it also reflects DNA’s connection with the nourishing land beneath their feet. Our earth mixture included sand and clay directly from the farm and soils taken from a nearby construction excavation. We sought to set a good example for our students and demonstrate how, even with a small project, we could cut into and leverage the local waste streams, establishing an ethos of environmental responsibility and economic resourcefulness that our student volunteers witnessed and expanded upon as they contributed to the construction of the project.

Rammed-earth construction is extremely labor intensive, often requiring large, complex formwork and hundreds of hours of ramming with a tamper. In most cases, when building with rammed earth the formwork is set for an entire wall, and successive layers of earth are added and compacted vertically until the full height is reached. Given the relatively small scale of our project, however, we decided to design light-weight, portable, and reusable formworks: one for the curved benches, one for the curved walls, and one for all the straight sections, whether bench or wall. This made the building process more agile for students and community volunteers with different physical capacities. These forms were inexpensive to construct, easy to assemble, and light enough to be moved around by anyone on site. Therefore, any of our volunteers were able, under our guidance or that of our students, to lay and re-lay formwork, mix and ram earth, and build the next section of wall as needed.

Each form consisted of two panels constructed of re-used scrap dimensional lumber and plywood, designed to be strapped together or capped at the ends depending on their placement within the composition. During construction, each form was set, a section of rammed-earth was laid, and once cured, the forms were released, moved to the next location, and reused (Image 3). Using this small-scale formwork lowered material and equipment costs, and provided students with additional on-site decision making experience as they repeatedly assembled and disassembled the formwork, responding to local challenges—changes in grade, unstable ground conditions, etc.—along the way.

Image 3. Formwork in the rammed-earth construction process.

Another limitation of using soil as our primary construction material came from our client-collaborators. Deaf aesthetics prioritize the clarity and functionality of visual communication, which required us to reexamine our habit of using building materials purely for affect. When we first suggested using local soil to construct an earthen structure, our collaborators immediately raised concerns about the color of the earth being too similar to skin tones, which could make hand-signing difficult to comprehend in the kitchen. As we built up the kitchen walls we explored the use of natural dyes to create bright colors that would provide better contrast with skin tones, ensuring that sign language could be clearly seen. We tested various dyeing materials, colors, hues, and techniques to find a solution—a blue wall—that aligned with both the needs and aesthetic preferences of our collaborators (Image 4). This exploration process led many students to develop a refreshed appreciation for low-tech construction and aesthetics informed by practical needs.

Image 4. Rammed-earth color testing and experimentation—including premixing dyes into the soil mixture and adding them to the sealant—to achieve the highest contrast for sign language visibility and bold colors.

Roof Structure

Building on the same ethos established in the rammed-earth elements, we aimed for a similar ethos of simplicity in on-site construction. We used off-the-shelf materials and simple attachment techniques for our roof structure that allow repeatability and legibility, so that the structure itself could act as a learning tool. We worked exclusively with three sizes of dimensional lumber—2x6, 2x10, and 2x12—and designed a process that required only basic tools to ensure that construction could occur effectively on our semi-remote farm site. While some components were pre-cut at the university woodshop and transported to the farm, the majority of the work was done in the field.

The shed structure is designed on a 13' x 13' grid, with six posts that were screw-laminated in the field by our students and erected in place in a single day. Each post was made by layering three 2x6s and fixing them together with screws, a technique that was not only cost-effective and efficient, but also educational (Image 5). As the structure is open-air, the laminations remain visible; the students can easily see how they were assembled and observe how surface friction improves the performance of the posts simply by "reading" them. This deliberate decision to make the structural connections visible was part of our didactic design and provided our students with a learning opportunity that they could easily share with others.

Image 5. Close-up photo of assembly details at roof support.

The longitudinal bracing, on the other hand, posed a unique challenge due to the need to accommodate the roof's slope and distribute structural loads. We originally planned to use a single 2x12 joist which could easily span the distance between two posts. However, we quickly realized it could not do so under the snow loads that would be imposed by the roof. We invited a colleague who teaches structures to join us and our students in our on site deliberations as we determined a solution to this problem. Our students were captivated by our discussion of member depth and weight, and the various ways in which different solutions would impact our framing details. In the end we decided to create a composite header-beam by sandwiching two 2x12s on either side of the posts and blocking them together at intervals across the span. This composite member performs like an 8x12 beam while maintaining the visual lightness of the structure. The visible gaps left between the two 2x12s reveal how they work together to achieve composite action and convey the same structural legibility as the laminated post details.

With the strengthened composite header-beams in place, we also had to develop a means to attach the sloped roof without notching the rafters—a technique that would have been impractical given our limited tools and rural location. Instead, we devised a "rafter saddle," a laminated seat that spans the composite header-beam with the roof slope already cut into it. These saddles also create a sandwich, with the roof rafters slotted between two outer flat-bottomed wedges. These, rather than a complex notching pattern, simplified construction, reduced errors, and reinforced the overall legibility of the structure.

The decisions to screw-laminate posts, to strengthen header-beams through composite action, and to fabricate rafter saddles were driven by responses to challenges encountered in the field. Our students delighted in working with us to solve these problems, later informing us how much they learned about structural thinking through these on-the-spot conversations.

3. Sharing Knowledge

Witnessing this project evolve and adapting to different challenges every step of the way gave students many tangible construction stories to share. Whether using drawings to communicate design ideas to Deaf collaborators, demonstrating construction techniques to community volunteers, or explaining the reasoning behind structural joints, they exhibited remarkable enthusiasm in conveying the anecdotes and knowledge they gained throughout the project.

Whenever students taught a new volunteer to use the blue dye, they told the full story behind the choice of color. They would discuss the meaningful decisions informed by practical needs to help the volunteers become more interested in and aware of the design process and underlying philosophy, rather than simply instructing the volunteers to execute a given task. Giving students additional responsibility for teaching and leading community volunteers gave students a new appreciation for the value of the knowledge they were gaining both in school and on site. With all of our on-the-spot decisions embodied in the structure, the building itself became a repository of knowledge that welcomed reading and studying by future visitors.

The stories of overcoming challenges and coming up with creative solutions not only strengthened the students' understanding of the work, but also fostered a strong sense of pride and ownership of the project. Their active engagement also transformed the construction site into a dynamic learning environment, where the exchange of ideas and skills became central to both the process and the final outcome.

4. Reflecting on Our Own Limitations

As we discuss the value of learning from limitations, it is equally important to acknowledge and critically reflect upon the limitations inherent in our own particular embodied knowledge and lived experiences. For some of us, and many of our students—who are all hearing people, this was our first meaningful interaction with Deaf individuals. Through our collaboration, it became clear that our Deaf client-collaborators, like many others within Deaf communities, do not view themselves as disabled. Instead, they embrace Deafness as a cultural identity, and assert that it is simply a different way of experiencing the world and living life. Thus, throughout our collaboration, we approached Deafness in this way—as a specific culture with its own languages, values, and traditions—one to which we do not claim to belong to but strive to learn from, engage with, and adapt to.

Students encountered several specific challenges in navigating this cultural engagement, particularly regarding safety on construction sites. Practical considerations arose around issues such as ensuring safety from falling objects, tripping hazards, or identifying unexpected wildlife hazards such as a wasp nest, and how to communicate swiftly without relying on speech or sign.

Seeking guidance on construction safety tailored specifically for Deaf individuals, our team quickly realized the significant inadequacies within existing frameworks for accessibility in architecture and construction. Architect and educator Joel Sanders emphasizes that these frameworks often "lack a more nuanced understanding of the complexity of human differences relevant in the twenty-first century"[3] and we need to search for a new, more expansive approach with refreshed understanding. Our experience working directly with a Deaf community clearly exposed some of the biases and shortcomings of ADA and Universal Design that tend to reduce accessibility to a checklist of requirements rather than a conception of lived experiences.

This theoretical critique also deepened students' understanding that disability or differences in abilities should not be viewed merely as an individual's physical limitation, but rather as a result of how societal norms and spatial configurations create barriers. This insight challenged assumptions previously unquestioned in classroom settings (for example, the assumption that ADA offers sufficient guidelines for accommodations), leading to a critical awareness of the societal and spatial dimensions of accessibility. Reflecting on communication, safety, Deaf cultures, and construction for all, students expanded their perspectives and understanding of the nuanced and individualized approaches required to form a truly inclusive collaborative relationship. Ultimately, we reflected deeply on the responsibility designers and builders carry to recognize and continually challenge the limitations of their own perspectives, and recognized the imperative to expand our knowledge continuously, to critically reassess conventional norms, and to redefine accepted truths within design and construction fields.

Conclusion

Small, low-tech, and incremental projects like ours can be transformed into a meaningful design-build exercise for students, and hold significant potential for exploring alternative practice models. We avoided reliance on high-budget resources, fast-tracked methods, and teams of experienced workers, and instead embraced a slower, more deliberate construction process that unfolded over months and evolved as it progressed. While this approach required patience, it allowed students the space to identify challenges, refine workflows, and explore creative solutions collaboratively in real time. For example, though we purchased a metal ramming tamper, it was not long before the students abandoned it in favor of ramming earth with the ends of pieces of scrap wood in order to have greater precision at the edges and corners of our formwork. Continual reimagining and honing of the process challenged preconceived conventional expectations of what is most suitable or effective to get the job done. The gradual pace of the work also offered moments to identify new design opportunities mid-build. The earthen walls were originally designed to be six feet tall, but as they grew, it became clear that at that height, they would cut off all visual access to the farm beyond. Instead, they were capped at four feet (Image 6). A standalone segment of that wall was left even shorter when its potential as a functional shelf became apparent. This serendipitous discovery, made possible by the slower pace of construction, exemplifies the value of flexibility and openness to evolution during the design-build process.

Image 6. The kitchen wall is a result of many discoveries.

The challenges we encountered in the field did not necessarily act as a hindrance, but rather gave students the opportunity to engage in on-site design discussions and take part in spontaneous problem solving. We provided a rough framework and guiding principles, but left room in the process for students to meaningfully contribute rather than simply executing a design prearranged by the faculty. Beyond acquiring construction techniques, students gained invaluable real-world insights—such as problem-solving, collaboration, and adaptability—that enrich and complement their studio education. Designing alternative processes to navigate constraints proved to be an essential and rewarding aspect of hands-on learning (Image 7).

Image 7. Students and community volunteers building and learning together.

Notes:

1 The three authors contributed equally to this work and are designated as co-authors.

2 We strategically gave multiple examples of desired textures to account for different life experiences and levels of access our volunteers may have had. Most student volunteers could picture Play-Doh texture easily, while farmers and church volunteers immediately knew the texture of cow manure.

3 Sanders, Joel, "Design for All: Challenges, Opportunities, and Conflicts Posed by Inclusive Design," *Design for All? Inclusive Design Today* (Spector Books, 2024), 46.

4 Our structural advisor is Sinéad C. Mac Namara, Associate Professor at Syracuse University.

5 Our core student volunteer team includes four Syracuse School of Architecture students: Tru Truong, Aryan Ambani, James Barbier, Sara Lin. We are grateful for all students and community volunteers who took part in the construction of this project.