DDBC RESIDENCE ONE

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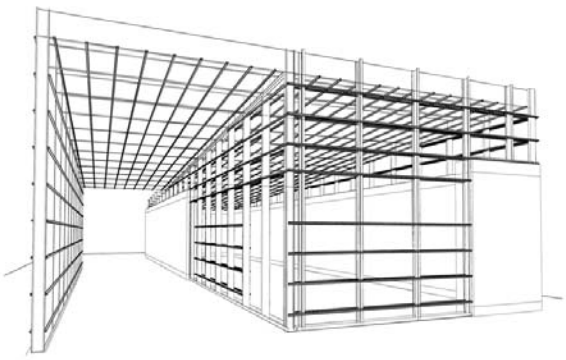


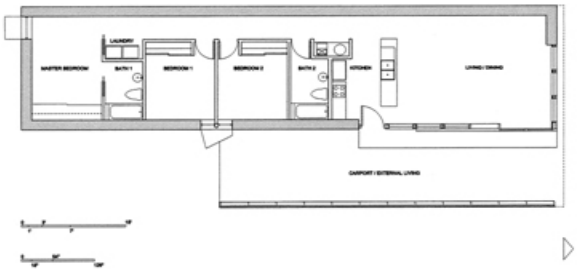
Institutional Context

The College of Architecture and Landscape Architecture at the University of Arizona recently created The Drachman Design Build Coalition (DDBC), a non-profit housing organization that offers faculty and student technical expertise to the local community in an effort to produce prototypical, energy-efficient, low-cost dwellings. Each prototype is permitted as a model residence and the plans made available to non-profit and for-profit homebuilders with the intention of disseminating regionally specific design strategies to a broad audience. The first residence built under our newly incorporated non-profit status, RESIDENCE ONE is a rammed earth and steel frame dwelling that houses a family with an annual income level below 80% of the mean household income level for the Tucson metropolitan area. The College partnered with another local non-profit agent, Chicanos Por La Causa, to identify a low-income family and guide them through homeownership courses and budget counseling.

Design Process

RESIDENCE ONE was designed by two professors, then drawn and constructed by students of the School of Architecture. While the design was developed with a high degree of specificity by the faculty members, there were opportunities for each student to contribute to the detailing of the materials assemblies, especially at the building's thresholds.

Conceptually, the project is comprised of a series of folded planes work in tandem with chosen materials to achieve proper solar orientation and energy efficiency. A thick rammed earth wall folds from west to south to east exposures, shielding the interior from the harshest solar gain. The translucent polycarbonate panels fold from north to the shaded east wall, admitting daylight at the most favorable exposures. Corrugated metal panels fold from the high west wall over the roof and down the east wall, reflecting the sun and protecting the large, sliding door panel that opens the living room to the outdoors.

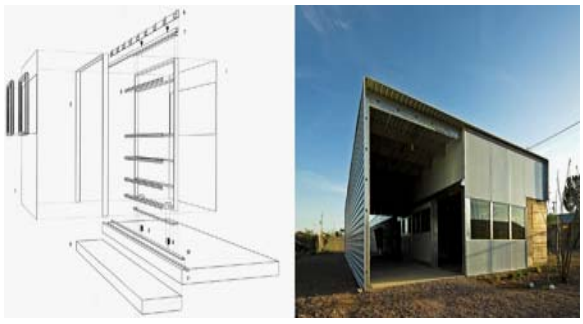


Environmental Context / Material Response

The residence was constructed on an infill lot in a neighborhood within the City of Tucson Empowerment Zone. The context is a comprised of a large stock of houses built from the 1920's to the 1950's, in generally poor condition, with a few new houses on infill lots. This house accommodates a stable, working family in a distressed area.

This dwelling serves as an energy- conscious prototype for the long, narrow lots with predominantly east-west solar exposure so commonly found in Tucson. It is difficult to control unwanted solar gain when most of the exterior wall and window area faces east and west. RESIDENCE ONE has an eighteen-inch thick rammed earth wall along the seventy-six feet long west exposure, with no openings for solar gain. The thermal mass of this wall behaves as an energy flywheel, slowly gaining heat during direct sun exposure but re-radiating it into the cool night sky before it can enter the interior of the home. This strategy is particularly well suited to hot-arid regions.

The south and most of the east wall is rammed earth as well, with the protected north wall and east wall under the carport roof built as steel frame with operable windows or translucent polycarbonate sheathing. A large, sliding door panel opens the living room up to the carport space, which doubles the public space for the eight months of the year when it is pleasant to live outside in this climate.

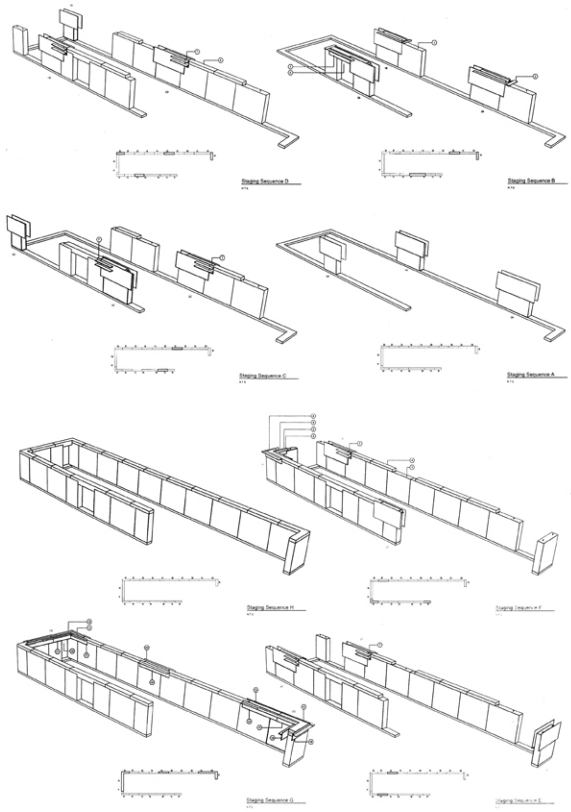


The landscape will also participate in the passive solar strategy for minimizing utilities costs in the residence. Deciduous palo verde trees were planted on the south side of the house to shade the rammed earth wall, and fast growing eucalyptus were planted along the west side to quickly gain shade for that exposure. Two fruit trees (lemon and pomegranate) are planted near the east carport where they will receive roof water run-off. Agave and ocotillo are used in the front yard where little run-off water is available.

The construction materials were chosen for durability and thermal properties. Rammed earth is sealed and never has to be painted, plastered, or patched. The steel roof and wall panels are warranted for 30 years, and the steel framing is termite-proof. The polycarbonate panels are more resilient/robust than glass and are warranted for ten years against UV discoloration. Donations from several community partners have helped make this project feasible. A local steel supplier offered an innovative engineering design for the steel framing, and the concrete footings and floor slab were donated by a well established construction company. Except for the concrete floor, plumbing, and mechanical work, all of the construction was done by students and faculty. The xeriscape landscaping was designed by students in the Landscape Architecture school and implemented by local High School National Honor Society students.

Construction Process

The faculty and students involved in this project designed the methods of construction to reduce the cost of dwelling by avoiding the necessity for heavy equipment, expensive materials and customized tools. The formwork for the rammed earth walls, for example, was designed and fabricated of lightweight plywood and dimensional lumber held together with pipe clamps. This armature could be assembled and disassembled quickly by only a few people with no lifting equipment, and enabled the re-use of the same pieces multiple times. The formwork was also configured to allow the bond beam to be poured before removing the forms by holding back the concrete the length of the required rebar splice, thus allowing the reinforcing steel to be continuous even though the concrete was poured in small batches.



The glass blocks used for illumination in the long west wall were made of bottles collected by students and slumped in a glass kiln. Additionally, students invented a handheld method of tensioning the steel cross bracing necessary in the roof plane, avoiding the rental of an expensive tensioning device, thus allowing the use of cross bracing as a substitute for expensive hat channels. Finally, the design of steel offset plates and welded window boxes accommodated factory built glazing elements in a way that incorporated shading elements on the exterior and seating elements on the interior.