THE TEKOA BOYS' HOME
A Melding of Vision, Functionality, and Sustainability

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INTRODUCTION

Community Housing Partners (CHP) is a 501(c)(3) community development corporation that serves the needs of low-income and low-wealth individuals and families in the southeast. CHP's mission is to create affordable, green, sustainable housing opportunities and services for the people and communities they serve. Since 1975, CHP has served over 206,000 people, including the elderly, women and children in transition, formerly homeless people, single female heads-of-household, and other individuals of low-income and low-wealth. Their activities include sustainable development, architectural design, construction, energy services, homeownership facilitation, housing management, and resident services. These efforts, in concert with public and private partnerships, enable us to create and sustain Communities of Choice that promote vitality in neighborhoods, foster wealth-building for individuals, and contribute to a better environment for future generations.

In 2002, CHP's architecture department, Community Design Studio (CDS), was approached by Tekoa, Inc. to create a residential facility for local at-risk teenage boys in Christiansburg, Virginia. The new home would also offer a counseling and special education program. As part of Tekoa's approach to therapy, it was important to the organization's leaders that the facility imbued a feeling of safety, comfort, equality, and acceptance. The client envisioned a place that was close to the youths' homes, thereby allowing for family interaction, and was also highly durable so that it could withstand the vigorous wear and tear often associated with teen behavior.

About this time, CHP launched a major initiative called "Down to Earth," committing itself to environmental, economic, and socially-responsible design, construction, and services. The creation of Tekoa would be an excellent opportunity to incorporate CHP's principles of sustainability with the owner's vision of a durable, holistic environment for young men.

After carefully weighing the feasibility of design and LEED® certification against the needs of the client, it was decided that there would be many benefits to incorporating LEED guidelines into the project.

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During the design process, it became demonstrably clear that sustainable strategies and practices are best implemented when they cover all three facets of responsible buildings: environmental, economic, and social. While choosing one focus over another generates inherent tension, choosing a single idea to address all three elements of sustainable design fosters accord. Admittedly, some ideas may be in direct opposition, whether due to client requests, building materials, project budgets, or time frames; but the challenge of any sustainably-built project is to reconcile different goals and desires into a clear set of priorities, and the LEED formula can be an effective method for merging ideas.

"CHP's mission has always been to provide safe, affordable housing for our clients. By incorporating green products and sustainable features into the Tekoa project, we were enhancing that goal, making the building safer for the residents and gentler on the environment," says CHP President and CEO Janaka Casper. "The energy-efficient features made it more affordable over the long run. But an important part of our goal was to give our residents an environment they can feel good in—emotionally, as well as physically."

KEYWORDS

charrette, collaborative design, construction waste management, ENERGY STAR®, geothermal heat pump, LEED, group home, Indoor Air Quality (IAQ), integrated design, native landscaping, residential treatment center, storm water management, Solar Reflectance Index (SRI), sustainable

ABOUT TEKOA, INC.

Established in 1994, Tekoa, Inc, was a non-profit corporation which provided residential care and special education services for at-risk youth. With four facilities, the organization employed teachers, therapists, and counselors to provide housing, education, and life-skills development for approximately 50 young men and women each year. Using a strength-based model, Tekoa utilized experiential learning such as therapeutic recreation, community service, and equine activities to facilitate healing and healthy development for its clients.

THE TEKOA BOYS' HOME

When it was constructed in 2004, the Tekoa Boys' Home was a twenty-bed therapeutic residential facility for young men between the ages of 12 and 17, situated on the top of a ridge overlooking the historic Cambria district in Christiansburg, Virginia. The four-acre project site was located on a lot that consisted of 15 total acres, while the facility itself measured 10,871 total square feet. Designed and built to LEED Silver standards by CHP's architectural and construction teams, this new construction project became an award-winning example of low-impact, green, attractive, sustainable design. Participants in the project's integrated design charrette included government officials, industry partners, funders, and the Tekoa residents

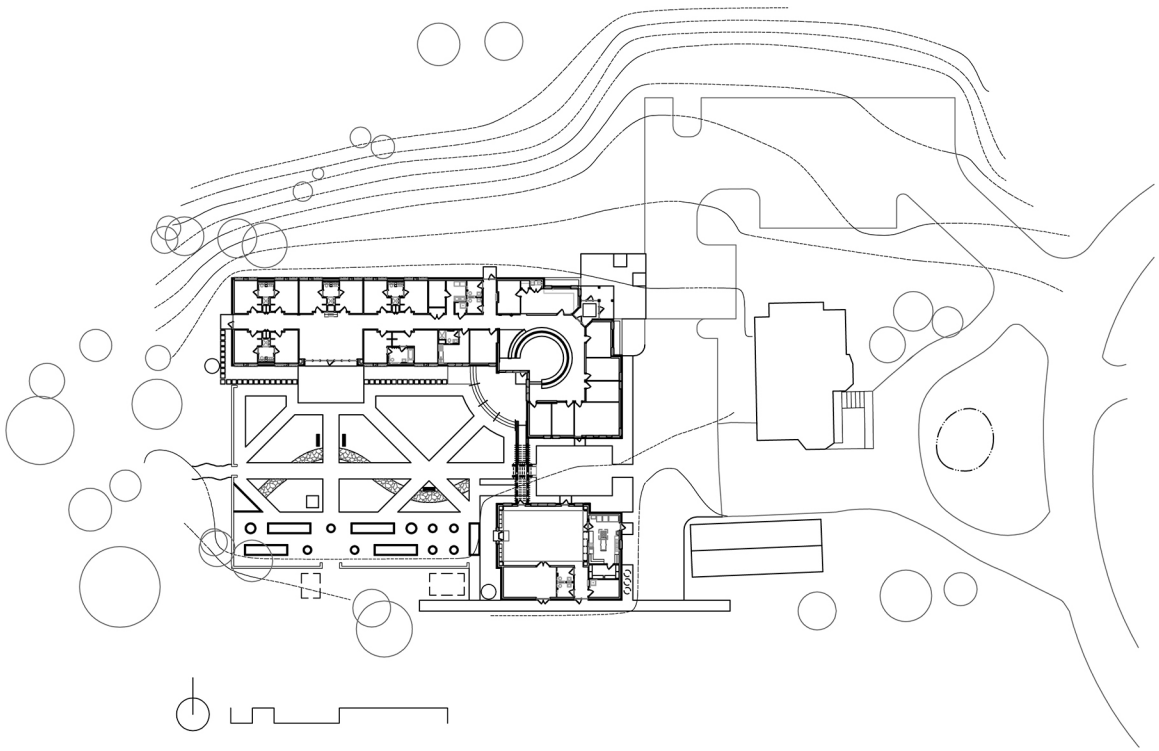
and staff. Stakeholder input helped shape the final design which resulted in a healthy, efficient, durable, and aesthetically-appealing environment.

At a total cost of two and a quarter million dollars, the project was funded by combining a Virginia Community Development Block Grant with other grants, tax credits, private loans, and gifts from partners, including the Federation of Appalachian Housing Enterprises and NeighborWorks® America.

The new facilities were situated behind and west of Tekoa's original classroom house and outbuilding, with views facing to both the north and the south. Woods to the west formed the remaining boundary of the site. Because CHP believes that a structure should be a place to both serve and provide meaning to the occupant's life, the two new buildings of the campus were designed around a private outdoor courtyard and focused inward in an attempt to create a place of solace and repose for the residents—many of whom came from difficult living and social environments.

The new campus facilities consisted of two parts: a long, linear, concrete masonry building containing dorm rooms, a central meeting room and administrative offices; and a rectangular concrete masonry building containing the dining room and small commercial kitchen. Parking was relegated to the perimeter of the campus to allow pedestrian use between all buildings. The formal entrance to the Dorm-Administration building was along a diagonal axis from the parking area through a series of rooms beginning with the entry porch, vestibule, meeting room, and on through to the private outdoor courtyard. Before entering the courtyard from the meeting room, a built-in circular meeting bench would direct one around the perimeter of the room—thereby extending the circulation sequence—before arriving at a modest lower area and then passing into the exterior courtyard.

FIGURE 1. Tekoa Boys' Home site plan.



The Dining Hall was situated south of the Dorm-Administration building and formed an exterior forecourt that is both an outdoor room between the buildings and an outdoor threshold upon entering the private courtyard. From the street, the new structures were partially concealed from view behind the existing house and outbuilding, appearing to closely hold the landscape due to the low-hipped roofs and strong horizontal emphasis.

The interior of the Dorm-Administration building was organized around the double-height meeting room. Views through the full-height re-entrant corner curtain wall extended the interior room outwards, while the corner clerestory windows allowed views of the corners and edges of the roof and provided a distinct sense of protective enclosure. The lower-height administrative spaces wrapped around this main room and the dorm wing extended down the corridor, forming the northern boundary of the courtyard. The primary materials were exposed—colored concrete floor slab and concrete masonry walls balanced by naturally-finished ash wood trim and bamboo flooring in the main public spaces.

FIGURE 2. Meeting room.

FIGURE 3. Meeting room during a group gathering.

LEED POINTS

As part of CHP's commitment to a more sustainable future, the decision was made to embark upon the process of LEED certification for this project. Sponsored by the U.S. Green Building Council (USGBC), LEED is a self-assessing system that evaluates a building's environmental performance from a "whole" building perspective over a building's life cycle and provides a definitive standard for what constitutes a green building. The LEED rating system is divided into five component parts: Sustainable Sites; Water Efficiency; Energy and Atmosphere; Materials and Resources; and Indoor Environmental Quality.

Because LEED points are interconnected, they are described in this article in terms of their relationships to each other.

In the **Sustainable Sites** category, the layout of the facility was carefully considered to optimize energy efficiency. The building was oriented with the long sides facing south and north to make the best use of natural light and passive solar strategies. The depth of the roof overhangs shaded direct light from entering the building in summer but allowed sun to reach deep into the perimeter spaces in the winter. The drop ceiling along the corridor created space above for the main mechanical duct work, thus keeping most of the ductwork below the attic

FIGURE 4. Dorm-Administration building floor plan.

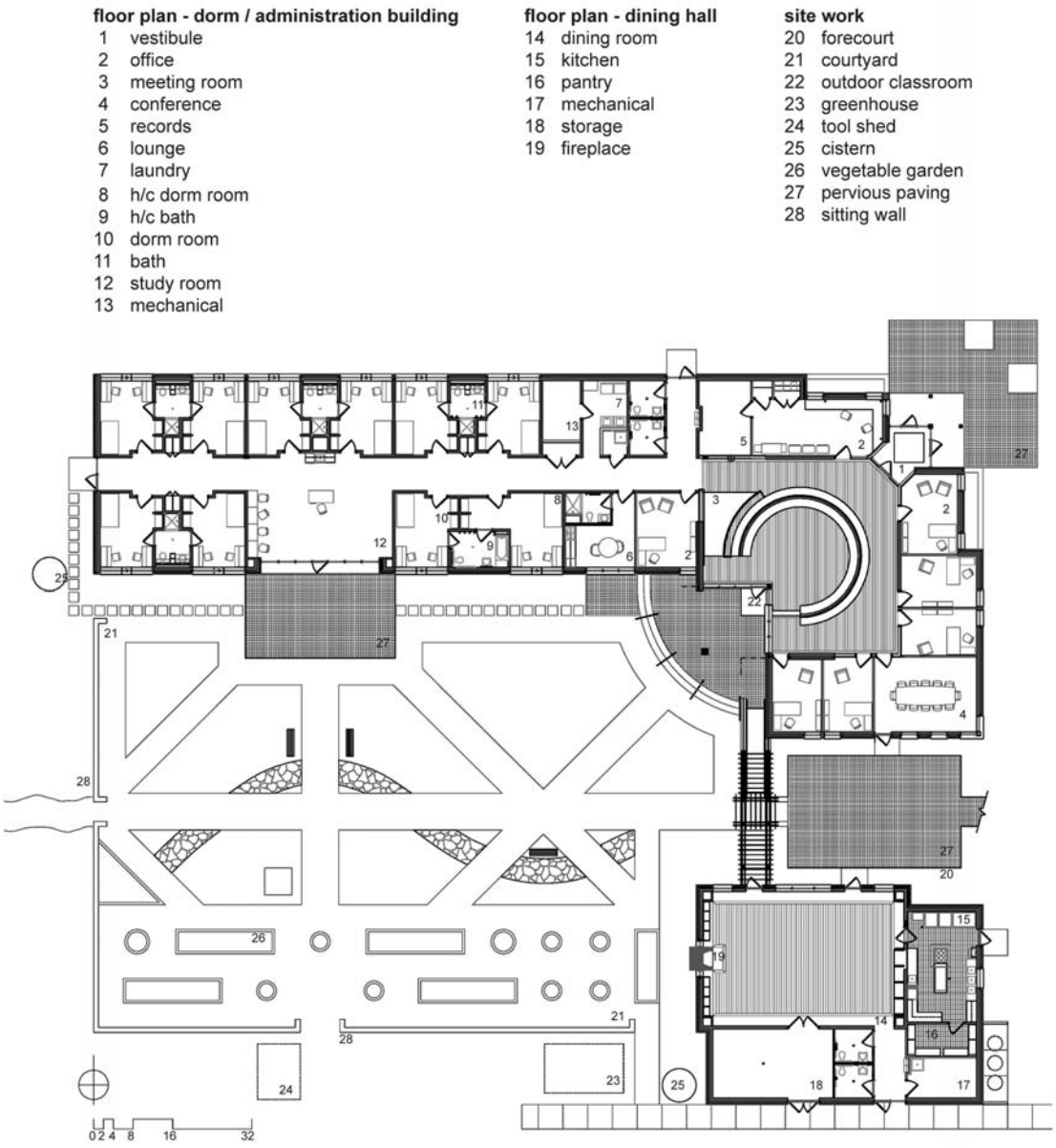


FIGURE 5. Tekoa Boys' Home entrance.

level and within conditioned space. These solutions were incorporated into an overall plan to help the building be 45 percent more energy efficient than baseline.

LEED V2.1 – Sustainable Sites, Credit 1
LEED V2.1 – Energy and Atmosphere, Credit 1

Site disturbance on the project was also minimized to occur only in existing open areas, and no trees were removed. Because the building was planned in a previously developed area at the edge of downtown and maintained the smallest feasible footprint, the total construction area was limited to well below 25 percent of the entire parcel area. During development of the construction documents, care was taken to delineate and survey the physical limits of disturbance and construction.

Efforts to eliminate storm water runoff included the use of pervious paving and bioretention basins. Open-grid pavers in the parking areas reduced storm water runoff from the site by allowing it to naturally filter through the ground.

LEED V2.1 – Sustainable Sites, Credit 5

An ENERGY STAR- rated roof was installed over 100 percent of the building to reduce the heat island effect of development. The Galvalume metal roof had a high Solar Reflectance Index (SRI) which minimized solar heat gain. Light-colored concrete walkways and open-grid pavers in the parking areas also reduced solar gain, thereby lowering the heat island effect on the site.

Lightometric studies and plans were generated to predict the foot candles of light projected from the building and site lighting. This step was also important to minimize the amount of light trespass on nearby residences. In addition, site lighting fixtures were chosen from Dark Sky options that limited the amount of light pollution, which has been known to disrupt ecosystems.

LEED V2.1 – Sustainable Sites, Credit 7.1 and 7.2
LEED V2.1 – Sustainable Sites, Credit 8
LEED V2.1 – Energy and Atmosphere, Credit 1

Along with the provision of outdoor bicycle storage, a public shower and changing room were incorporated to accommodate building staff who biked or walked to the building.

LEED V2.1 – Sustainable Sites, Credit 4.2

The strategy employed in the **Water Efficiency** category included selection of water-efficient landscaping, the harvesting of rainwater in cisterns for all landscaping, and the installation of water-efficient plumbing fixtures. Plantings added to the site were native and drought-tolerant, and therefore did not disrupt the existing species or require regular watering. Because the site work did not include an irrigation system, two 5,000-gallon cisterns were installed above ground to supply all landscape watering needs. Originally, the visible cisterns were used as a demonstration for youth enrolled in the gardening curriculum of the Tekoa program.

LEED V2.1 – Water Efficiency, Credit 1

FIGURE 6. Dining Hall exterior with rain cistern.

The most significant feature used in the **Energy and Atmosphere** category was the installation of a geothermal water source HVAC system, which was monitored and controlled by a computer-based sensory network. The system self-regulated and performed 45 percent more efficiently than similar building types as compared to the ASHRAE 90.1-1999 energy standard. Although original plans called for all of the geothermal wells to be vertically installed under the courtyard, existing soil conditions dictated that the design team move to a "hybrid" well installation. As a result, five vertical wells were installed approximately 150′ deep in the courtyard area to supply the heating and cooling needs of the dining facility. Eight horizontal wells, at 300′ each, were then installed 6′ below ground in the lower parking area to service the Dorm-Administration building. Anecdotally, the young residents at Tekoa would occasionally point to the open yard around which the building is situated (and where the vertical wells were installed), referring to the area as their mechanical room.

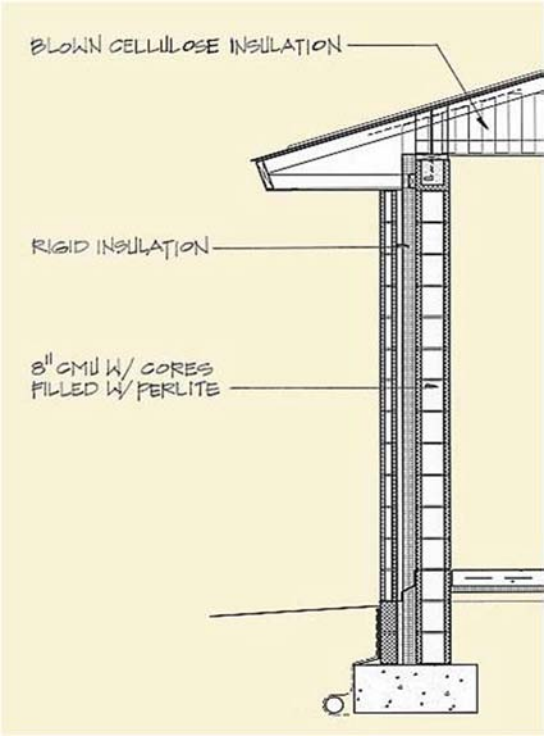
LEED V2.1 – Energy & Atmosphere, Credit 1

LEED V2.1 – Energy & Atmosphere, Credit 5

FIGURE 7. Geothermal HVAC system pipes and pumps (with valves to fire sprinkler system).

FIGURE 8. Wall section.

FIGURE 9. Wall sectioning.



Rigorous energy modeling was performed to optimize the performance of the building envelope, which included calculating the buildings' heating and cooling needs for every day of the year. Although the design team had initially planned to fill the facility's eight-inch CMU walls with perlite insulation, the energy-modeling results indicated only four-inch rigid insulation was necessary to optimize the building's insulation. The design team ultimately achieved an R20 wall insulation level and an R38 attic insulation level, while also incorporating an appropriately-sized mechanical system. The same energy models helped demonstrate and calculate the appropriate amount of under-slab insulation to be installed. Energy modeling also led the design team to use a double wythe concrete block wall with an insulated airspace to reduce the effects of thermal bridging. Further modeling allowed the team to fine-tune the roof overhang depth to ensure the right amount of solar gain.

Given the dormitory use of the facility, controllability of the lighting and mechanical systems was important for everyone's comfort. The lighting throughout the building was controlled by occupancy sensors. Sufficient amounts of daylight to most regularly occupied spaces reduced the need for overhead lighting. Energy-efficient light fixtures reduced the electrical load of the building and limited overall energy consumption.

LEED V2.1 – Energy & Atmosphere, Credit 1

Featured in the **Materials and Resources** category is a construction waste management program that diverted 79 percent of construction waste from area landfills to recycling and the use of Forest Stewardship Council (FSC) certified lumber in over 65 percent of total wood products. Wood-based materials comprised the structure, window framing, cabinetry, floor finishes, and wall finishes. Additionally, waste masonry units were crushed and used as base material for the parking areas, in lieu of sending the material to the landfill.

The use of durable materials such as wood, concrete, and concrete masonry units (CMU) helped to ensure the longer life span of the building finishes. These materials also contained fewer toxins than frequently replaced materials such as carpet. In addition, the LEED Materi-

FIGURE 10. Meeting room detail.

als and Resources prerequisite for storage and collection of recyclable materials provided the basis for a facet of the Tekoa curriculum. The administration and young men living at the facility adopted the mantra "reduce, reuse, recycle" into the operation of the program, making use of the recycling stations throughout the building to divert reusable materials from the landfill. Items including paper, cardboard, plastics, metal, glass, batteries, and electronics were collected and then sent to appropriate recycling facilities.

LEED V2.1 – Materials & Resources, Prerequisite 1
LEED V2.1 – Materials & Resources, Credit 2.1 and 2.2
LEED V2.1 – Materials & Resources, Credit 7

The **Indoor Environmental Quality** category included the use of low-VOC paints, adhesives, sealants, and finishes. A construction Indoor Air Quality (IAQ) management plan was implemented both during construction and before occupancy. Permanently installed walk-off mats at major entrances reduced the amount of dirt, pollen, and outdoor contaminants entering the building. Designated chemical mixing stations for janitor use were kept separate from public spaces and ventilation intakes to eliminate exposure to potential toxins.

LEED V2.1 – Indoor Environmental Quality, Credit 3.2
LEED V2.1 – Indoor Environmental Quality, Credit 4.1, 4.2, and 4.4
LEED V2.1 – Indoor Environmental Quality, Credit 5

With a long, narrow plan, nearly every room had windows with unique outside vistas. Indirect natural light was incorporated into the design to foster a strong connection between inside and outside spaces. Over 93 percent of the regularly-occupied perimeter rooms (which was every room of the facility except for three) had operable windows. The windows were a source of ventilation and also provided outside views for the occupants.

LEED V2.1 – Indoor Environmental Quality, Credit 6.1 and 6.2
LEED V2.1 – Indoor Environmental Quality, Credit 7.1 and 7.2
LEED V2.1 – Indoor Environmental Quality, Credit 8.1 and 8.2

Under the **Innovation and Design** category, CHP sought to integrate the resident-user and building-facility by promoting the implementation of a landscaping and horticulture course curriculum for the students in which they could learn life skills in the care and stewardship of all garden features in the landscaped outdoor courtyard of the project. The students were also given a hands-on role in caring for the property's rain gardens and taught to respect the porous grass paving grids, which were a combination of concrete, soil, and grass. The Tekoa Boys' Home became a model for energy efficiency and environmental stewardship, often utilized as a case study for Virginia housing organizations, other regional nonprofit organizations, and architecture and construction students from area universities seeking to employ or learn more about sustainable building practices.

Tekoa ultimately earned LEED Silver certification, garnering a total of 34 points. The project was also awarded the Virginia Sustainable Building Network 2005 Virginia Green Innovation Award for Best Institutional Project and the Governor's Housing Conference 2004 Virginia Housing Award for Best Housing Development.

THE DESIGN PROCESS

The design process for the Tekoa Boys' Home took place in approximately one year's time, which required that all of the project stakeholders work efficiently and effectively to ensure its successful execution.

The first step of the process involved a programming meeting between the client and design team in order to establish the facility needs and goals for the group. This is a critical step to the overall economy of a building project. Following this initial meeting, a design charrette with the client, designer, contractor, civil engineer, mechanical engineer, and LEED consultant was held. This charrette was funded by a Rebuild America grant received by the

FIGURE 11. Tekoa Boys' Home rendering.

FIGURE 12. Rear exterior view of Dorm-Administration building and outdoor courtyard.

Virginia Sustainable Building Network (VSBN), who originally suggested the Tekoa Boys' Home project consider LEED design and construction standards. Here, the involved parties evaluated the feasibility of pursing LEED certification and how it would fit with the economic and functional parameters of the project. By considering how the goal of sustainability matched up against 1) the client's needs, 2) the budget, and 3) the materials selection, the project team determined LEED would be a beneficial guide in creating the Tekoa Boys' Home facility. It was also decided at this time that a full-time LEED consultant would be hired to help facilitate the process. After additional charrettes, schematic designs were created and vetted, subsequently followed with construction documents.

What ultimately resulted from the design process was the marriage of vision, functionality, and sustainability. As an integral element to the whole campus, the exterior courtyard of the inwardly-focused structures fit all three of these elements. The outside space served as an open sign of reflection, meeting the desires of the client. Functionally, it served as the geothermal resource for the building. It also served as an environmental gesture signaling CHP's commitment to sustainable housing.

Another important aspect of the project was its durability as a physical structure serving the immediate needs of its youth residents, and as an environmentally-responsible structure that would last for future generations. Recognizing that the young men living at the facility were likely to be hard on the building and that earlier Tekoa residences required ongoing maintenance as a result of significant wear and tear, the project team determined that the selection of durable materials and finishes was crucial. This meant the selection of concrete floors and concrete masonry units (CMUs), which also prove to be cost effective and readily available.

Specifically, the wall section was comprised of eight-inch CMUs, which served as the interior finish material and structural bearing wall component. Four-inch CMUs formed the exterior veneer of the building with four-inches of rigid, R20-rated insulation in the wall cavity. These materials were then made aesthetically warmer and more inviting by complementing them with abundant natural daylighting, natural wood, and colored pigments made from locally reclaimed mine waste.

Following completion of the project, a third-party consultant was hired to compile and audit CHP's LEED submission and provide guidance for successfully achieving certification.

CONCLUSION

The Tekoa campus highlights CHP's commitment to environmental, social, and economic sustainability outcomes. This project gave the organization an exceptional opportunity to "walk the talk" it had been engaged in for years about green building and sustainable issues. CHP was able to focus on the ecological and economic components of the project by using the LEED model, which helped minimize the facility's impact on the environment and reduce long-term maintenance costs. CHP also focused on achieving social sustainability by utilizing the building as a teaching tool in which an emphasis was placed on the building as a part of the ecosystem.

And, as in most endeavors, CHP, CDS, and Tekoa learned a number of important lessons during the course of this project.

First and foremost, the project team determined the LEED scoring rubric is an important tool for the evaluation of projects and critically reviewing the appropriate application of any green scoring/certification structure. However, some projects are well-suited to, and closely aligned with, the ideals and goals of the USGBC while some are not. It is the incumbent responsibility of each designer to be honest with their clients while reviewing LEED requirements. The Tekoa project demonstrated that, overall, it was a good fit for LEED certification, though there were some particular aspects that were not.

For example, the operable windows required for fresh air by the energy model and LEED prerequisites were not appropriate for this particular project. Due to the nature of the facility, there were strict rules regarding the coming and going of the young men living there. Unfortunately, the residents quickly took advantage of the small dorm room windows as a way to exit the buildings undetected. Hindsight forced the design team to reconsider its strategies for practically implementing this LEED point.

Because durability was paramount to the project, wood and concrete flooring was used throughout the facility, eliminating potential indoor air quality issues that would have arisen with the use of carpeting. Unfortunately, LEED would not allow points for this design feature at that time.

It was also important to the original leaders of Tekoa that the dining hall have a fireplace, as it was seen as a symbol of comfort. In terms of the energy model and maintaining a high indoor air quality, an open fireplace was a poor way to control the building's air circulation. In this case, however, the building itself was symbolic of concepts pre-dating building science, where the hearth was the heart of the home and an ancient symbol of warmth and connectivity. Meeting the needs and desires of the client were thus given priority over this particular LEED guideline.

FIGURE 13. Dining Hall interior with fireplace.

Tekoa also reaffirmed how critical a design team charrette is to success. Every building project involves people, and every building project is a balance of design, constructability, cost, time, quality, and goals that only concludes when the project is complete and fully realized. For these reasons, an early meeting of the minds is vital to understanding the best strategies for balancing the priorities of a project and understanding the connections between the project systems.

It was during the site-planning phase of Tekoa's charrettes that a well-woven set of ideas for the program curriculum, storm water management, mechanical systems, and building lighting evolved. Together, the L-shaped main building and separate dining hall dictated the placement of the geothermal wells and trenches and provided near-ideal locations for storm water filtration sites. While offering a distinctly separate space for meals and large gatherings, the dining hall incorporated large, north-facing windows that faced the main building and yard. These design steps had a multifaceted effect and were further developed because the owners, project engineers, architect, and general contractor were all discussing them together.

Since the Tekoa Boys' Home was completed in 2004, it has seen significant changes. In 2007, CHP sold the Tekoa line of business, which was subsequently closed in 2009. Since that time, the building, which is still owned and maintained by CHP, was then renovated into the new corporate campus for CHP and CDS.

The dormitory wing of the building was modified to fit the financial and administrative departments of CHP. The construction and architecture divisions of the organization are now located in the former dining hall. The main kitchen was changed into a meeting room and a small mezzanine was added to the 19-feet-tall space.

The project is now registered for and pursuing LEED – Existing Building certification and has strategies in place to become a Net-Zero building within the next few years.

PROJECT TEAM

Owner: Community Housing Partners
Tenant: Tekoa, Inc.
Project Manager and Architect: Colin Arnold, AIA, LEED AP, Community Design Studio, a subsidiary of Community Housing Partners
Structural Engineer: Steve Brooks, Thompson + Litton
HVAC Engineer: Robert Somers, PE, 2rw Consultants
Civil Engineer: John T. Neel, Gay and Neel, Inc.
Landscape Architect: Dan Mahon, ASLA, McGuffey Hill, LLC (former employer)
Contractor: Todd Peacock, Community Housing Partners
Environmental Advisor: Thomas Fisher, AIA, McGuffey Hill, LLC (former employer)