

## **Session Number**

# **LEARNING FROM NATIVE CULTURES: EDUCATIONAL OPPORTUNITIES IN SUSTAINABILITY, CULTURAL SENSITIVITY AND GLOBAL AWARENESS**

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**ABSTRACT:** At the dawn of the 21<sup>st</sup> century we live in a world plagued by her inhabitants. Increased consumption, depletion, contamination, pollution, and waste have led to the current fragile state of the planet. Financial pursuits have created wider economic gaps between those who have the knowledge and the ability to address environmental issues and those who do not. An increasing need for environmental awareness and sustainable principles is apparent not only in higher educational settings, but also at the individual and community level.

In every deliberation we must consider the impact  
of our decisions for the next seven generations.  
-The Great Law of the Iroquois Nation

The history of native cultures transcends the gap between man vs. nature. Traditionally, native cultures are highly respectful of and live in harmony with their natural surroundings. Today, these cultures are plagued with many of the harsh realities of rural America: lack of resources, inefficient and unhealthy housing, and limited access to education and jobs.

A partnership and an educational exchange between two major universities and a tribal college have been formed to address issues that challenge their respective communities. The objective of this exchange is two fold: 1) educate engineering students on concepts of sustainability and the practices and tradition of native cultures and 2) to partner with individuals in the community on the deployment of energy efficient and sustainable technologies. These objectives both promote lifecycle thinking with respect to the investment in better efficient facilities. This paper presents early lessons learned in the partnership through team work, leadership, problem solving, project planning and delivery combined with global awareness, cultural sensitivity, and versatility through this cross-disciplined, cross- cultural exchange of knowledge and experience.

## INTRODUCTION

Raised awareness exists on the need to reform the actions of the earth's inhabitants to maintain, sustain and increase the vitality of the world in which we live. The case for an environmentally conscience society which minimizes impact, reduces waste and decreases consumption has been made through research in life cycle analysis and projected consumption rates of natural resources. The question facing educators, engineers, and inhabitants of this planet remains: how are we addressing the need to embed this awareness among engineering students?

Traditionally, engineering programs educate students on technical information pertinent to each discipline, with limited regard to the impact of the surrounding environment or communities. The issue of environmental degradation gained popularity in the 1960s and continued throughout the 1970s. The engineering community responded by creating environmental engineering. Environmental engineering is a discipline dedicated to cleaning up the waste and pollution produced by society, and fellow engineers. The educational objective of environmental engineering curricula is to "...provide education in the prevention of pollution, and in monitoring, control and remediation of pollution sources on the Earth<sup>6</sup>." The programs are "oriented around solving environmental problems... and remediation of hazardous contaminants, physical/chemical processes for contaminant removal as well as conventional water and wastewater treatment<sup>5</sup>." The objective of environmental engineering is to minimize pollution and properly dispose of the waste. The very pollution and waste produced by the products of other engineering disciplines including, architectural, civil, chemical, structural, mechanical, electrical, industrial, and other technical design disciplines.

The authors propose an *end to environmental education isolation* and seek the incorporation of environmental principles into all engineering disciplines. Educators must seek a way to train socially and environmentally responsible engineers. To achieve this goal, engineering students must be introduced to principles in sustainability and armed with the inquiry skills needed to seek sustainable and environmentally sensitive solutions to engineering problems. In addition to technical expertise, it is the responsibility of the educators to provide students with the tools they will need if they are to act with social and environmental responsibility.

### **The World Class Engineer**

One version of the skill set described above is reflected in the characterization of a "World Class Engineer" as defined by The Leonhard Center's External Advisory Board at Penn State University. Comprised of a broad cross-section of industry leaders, including professors, CEOs, and presidents of major engineering organizations, the board has worked over the last two years to define five categories characteristics of the "World Class Engineer." The descriptions are as follows:

Aware of the world Engineers need to be sensitive to cultural differences, environmental concerns, and ethical principles. They need to understand market needs in both high and low-tech solutions.  
Solidly Grounded Engineering students need to be trained in the fundamentals of their disciplines, while retaining a historical perspective and an awareness of new advances and technologies in the field. Life time learning is an important theme.

Technically Broad Engineers need to realize that one individual or one discipline does not have all the answers. They must work with other disciplines to discover the most appropriate solutions. Broad thinking is important to see alternatives and other probabilities. Students need to be psychologically prepared to address new problems and discover new solutions.

Versatile Engineers need to be innovative in their solutions and see engineering as an application to a problem. Engineers must look beyond the boundaries of their jobs and consider applying engineering solutions to other disciplines and social problems.

Customer Oriented Engineers need to realize the importance of their customers, throughout the international arena. Engineers need to be sensitive to their customer's needs, values, and cultural traditions to provide appropriate services<sup>13</sup>.

An initiative at Penn State University has begun to address the issues of environmental consciousness and the principles depicted by the World Class Engineer model. The American Indian Housing Initiative (AIHI) is a partnership between two universities and a tribal college dedicated to improving engineering education through environmental and cultural awareness. This initiative explores how a combination of hands-on experiences and public scholarship mechanisms can provide effective learning opportunities in sustainable practices and technologies, cultural interaction, and social responsibility. A key element of the initiative is a partnership between educational institutions and a community in which applied projects are made available for engineering students. The cultivation of this partnership through the initial development of AIHI is presented here as a key enabling factor to this applied program in sustainability education.

The AIHI course series is divided into three distinct sessions. Part I (spring) of the course includes a lecture series on American Indian culture, history, and socio-politics in tandem with the study of sustainable building technologies, including: strawbale construction, passive solar strategies, water recycling, and wind power. Part II (summer) follows with a two-week "blitz-build" on location in Montana, where Penn State students and faculty, joined by University of Washington students and faculty, collaborate with tribal members in the design and construction of a green building. Part III (fall) concludes the course, providing students and faculty an opportunity for assessment and critical reflection of the experience, and to make recommendations for the continuous improvement of the course and the initiative (Riley and Workman 2003).

## **AMERICAN INDIAN HOUSING INITIATIVE HISTORY**

The foundation for AIHI was initiated in 1998 at the University of Washington. It has since evolved into a joint effort through Penn State University, University of Washington and Chief Dull Knife College. The partnership allows students from diverse backgrounds and cultures to participate in public scholarship. AIHI works to apply regionally appropriate green building technologies and sustainable development strategies on American Indian reservations through the creation of partnerships with tribal communities. AIHI is essentially a *learning exchange* between the tribal community and the academic community<sup>1</sup>. The current focus of AIHI is the Northern Cheyenne Tribe located in southeast Montana.

### **Specific AIHI Objectives**

- 1) Promote the teaching, learning, and discovery of green technologies and sustainable development strategies appropriate for the long-term prosperity of the Northern Cheyenne Tribe, while simultaneously promoting a cultural, scientific, and educational exchange among collaborators.
- 2) Develop a Community Built Housing Program for the Northern Cheyenne Tribe that will utilize indigenous materials and resources, green technologies, and sustainable development strategies.
- 3) Foster a sense of empowerment and sovereignty through the Community Built Housing Program, while arming community members with knowledge of technologies and strategies that will help to accelerate economic development<sup>7</sup>.

AIHI immerses students in intercultural, socially relevant activities that enhance the educational breadth of the program. The class operates within a yearly cycle in which students perform research, experiment, engage in problem solving, participate in teamwork, and apply the knowledge and experience they have gained to construct a facility on the Northern Cheyenne reservation. Open to students in many disciplines, AIHI students are encouraged to consider how to apply their individual talents to become agents for change. As emerging professionals, it is hoped that veterans of the AIHI course series will gain from their participation in the program to be more knowledgeable, more aware, and draw upon the skills they have learned to make ethical, socially and environmentally responsible decisions and contributions to the global community throughout their adult lives<sup>1</sup>.

### **Existing American Indian Housing Conditions**

Currently, American Indian reservations suffer from overcrowded, poorly constructed, poorly maintained homes.

- Sixty-nine percent of Native Americans in tribal areas must "endure severely overcrowded conditions in which 18, 20, or even 25 persons are jammed together in small two-bedroom houses<sup>10</sup>."
- In Tribal areas, over 32 percent of homes are overcrowded and have serious physical deficiencies. In comparison, in the United States as a whole, only 4.9 percent of households are overcrowded<sup>10</sup>.
- The average lifespan of a Plains Indian is 45 years<sup>8</sup>.

In 1962 the US Department of Housing and Urban Development (HUD) created the Model Tribe Ordinance. The ordinance determined that housing on American Indian reservations cannot be supplied by private enterprise and thus created Indian Housing Agencies/ Authorities (IHA). IHA's are responsible for three primary purposes: 1) to remedy unsafe and unsanitary housing conditions on the reservation, 2) supply decent, safe and sanitary housing for persons of low incomes, and 3) provide employment opportunities through the construction, repair and operations of low-income dwellings<sup>3</sup>. The Housing Authority for Northern Cheyenne Tribe is significantly under-funded and under-staffed. Building and producing new homes and servicing and maintaining the current housing stock is an arduous task. Many of the current homes on the reservation fall to disrepair due to their low-cost construction, inappropriate material choices and the lack of maintenance knowledge for the average renter/owner on the reservation. These conditions are amplified by the extreme weather conditions that exist in the central plains. For this reason, the Housing Authority struggles to service existing homes which hinders their progress in providing new and improved homes.

## Figure 1

### The American Indian Housing Initiative

Phase 1: Introduction, Conception and Planning	1999: Construction of White's Residence In Garryowne, MT
	2000: Construction of Fastwolf's Residence Red Shirt, SD
	2001: Construction of Bear Quiver's Residence In Lame Deer, MT
Phase 2: Building relationships and Infrastructure	2002: Construction of the Adult Education Center in partnership with the Chief Dull Knife College (CDKC) in Lame Deer, MT
	2003: Construction of the Model Home in partnership with the Northern Cheyenne Housing Authority in Lame Deer, MT
	2003: Cooperative Agreement signed to enhance educational experiences between PSU, UW and CDKC
	2003: Courtyard installation through Youth Restoration Art Project in partnership with the Boys and Girls Club and local artists
	2003: Thesis: Implementing "Self-Determined" American Indian Housing
	2003: Thesis: A "Whole House Design Process"
	2004: Technology Center at tribal college in Lame Deer, MT
Phase 3: Expanding Educational Experiences	Goal: Revamp of current AIHI courses to emphasize sustainable technologies/ practices and native cultures/ history
	Goal: Create a co-aligned course for CDKC to enable tribal students to participate in the build and earn college credit.
	Goal: Develop sustainable technology classes/ workshops to be held at the CDKC Technology Center in Lame Deer, MT
	Goal: Create an exchange program to allow university and tribal students an opportunity to experience one another's cultures first hand

Vision: AIHI works to restore a culture of self sufficiency on reservations through the use of regionally appropriate green building technologies and sustainable development strategies. AIHI is both a capacity building initiative and a learning and educational exchange between the tribal community and the academic community.

## **PROGRAM DESCRIPTION**

The American Indian Housing Initiative has developed through three phases since its inception in 1998. Illustrated in Figure 1, these phases represent a process in initial experimentation with appropriate sustainable technologies, and the building of trust within a community (Phase 1). Next relationship development and infrastructure building is pursued (Phase 2). Ultimately, a formal partnership between University partners and tribal organizations is established and the collective pursuit of a sustained learning exchange is pursued (Phase 3).

### **Phase 1: Introduction, Conception and Planning**

Phase 1 focused on the introduction of strawbale construction as an appropriate and sustainable alternative to current housing options to tribes in the Northern Plains. The first two projects consisted of the White Residence in Garryowen, MT and the Fastwolf residence in Red Shirt, SD. These projects established a presence for the partners initiative in the region while creating awareness about the straw bale construction. The first two projects sparked the interest for the third project, Bear Quiver residence on the Northern Cheyenne reservation. After completion of the Bear Quiver Residence several tribal leaders requested that the university partners return to develop additional straw bale projects on the Northern Cheyenne reservation. After establishing a discernable interest in strawbale construction and earning an invitation to return, university partners elected to pursue a long term relationship with the Northern Cheyenne and a larger scale and sustained effort to implement sustainable building technologies to address housing problems on the reservation.

### **Phase 2: Building Relationships and Infrastructure**

Initial experiences during Phase 1 allowed educators to observe an interest in tribal communities for sustainable technologies, which assisted university partners in developing relationships and building infrastructure throughout Phase 2. The primary strategy for this phase was to construct community buildings with key partners and increase community involvement and awareness in the program. These projects also served to develop organizational familiarity between the university partners and tribal entities, thereby improving the communication and cultural exchange of ideas.

Currently in its final stages, Phase 2 of the initiative has revolved around three construction projects designed and constructed by students and faculty in engineering and architectural disciplines: an Adult Education Center constructed in 2002 on the campus of Chief Dull Knife College, a Model Home constructed in 2003 jointly with the local housing authority, and planned for 2004, the construction of a strawbale technology center on the campus of CDKC. Each of these projects has contributed to strengthening relationships and increasing understanding of the challenges faced by tribal members and organizations. Additional results of Phase 2 include the establishment of Youth Restoration Art Project, a partnership between the two universities and the tribal college through the Cooperative Agreement, and educational and research opportunities for graduate and undergraduate students.

### **Phase 3: Expanding Educational Experiences**

Through the relationships and partnerships developed in the previous phase, Phase 3 will lead to the creation and implementation of sustainable and culturally appropriate housing solutions and

mutually beneficial educational experiences. The refinement and application of sustainable technologies such as straw bale construction and water conservation technologies will be applied to future projects. Further research will pursue increased educational experiences for students on and off the reservation, in addition to workshops and seminars offered for community members.

## **LESSONS LEARNED**

The unique relationships established between AIHI partners and a tribal community has resulted in useful lessons regarding the provision of meaningful educational experiences in hands-on environmentally sensitive problem solving, and the development of skills contributing to world class engineers.

### **Phase 1: Introduction, Conception and Planning**

The three initial projects completed by university partners had visible and measurable impacts with both students and faculty. The chance to both design and construct a building was, as expected, a powerful hands on learning experience for university students. As a result, the idea of combining service learning courses with environmental engineering practices was validated. In addition, valuable learning experiences arose from the emersion of students in another culture, in particular, a culture that maintains values of harmonious existence with the environment.

More importantly however, is the value of implementing sustainable technologies in a community where benefits, such as financial savings in energy use, are highly appreciated. Through this initial phase three tribal communities were exposed to energy saving sustainable technologies, which assisted in lowering heating bills during the long harsh winters. The benefit of such technologies was immediately apparent and appreciated by the families and acknowledged by the tribal communities.

From the organizational perspective, after constructing the White, Fastwolf and Bear Quiver residences in two different states, on three different reservations, in three separate communities, it became clear that a sustained meaningful impact would be most beneficial through an extended presence in a single region. Requests from Chief Dull Knife College and the associated tribal community led university partners to focus their energy on the Northern Cheyenne Reservation.

### **Phase 2: Building Relationships and Infrastructure**

The primary objective of Phase 2 was to build relationships and infrastructure for the dual purpose of refining and expanding the educational experiences provided to students as well as the impact of the program in the Northern Cheyenne community. The results to date through Phase 2 activities include: increased communication and understanding between the tribal and academic communities; the definition of clear working relationships and shared organizational goals; increased tribal interest in sustainable building technologies; annual sustainable construction projects; and the conclusions from targeted and applied research performed by faculty and graduate students.

### *Projects and Working Relationships*

The construction of the Adult Education Center (2002) established a working model for Phase 2 of the initiative. This model includes assistance from the Universities for tribal groups seeking financial support for much needed buildings from federal agencies like HUD and the USDA Rural Development program. The Universities provide pro-bono design, project management and the coordination of volunteer labor to keep the costs of projects to a minimum. The Adult Education Center, located on the campus of Chief Dull Knife College, resulted from a growing relationship between the universities and tribal college, thus resulting in the Cooperative agreement the following year.

This model was repeated in the construction of the Model Home in partnership with the Northern Cheyenne Housing Authority. This project's location and local publicity produced increased interest throughout the community. In addition, faculty and students had the opportunity to engage in community meetings and decision processes. This resulted in a better understanding of political climate, culture and decision processes that would influence future projects. Currently, AIHI partners have a two year back-log of funded projects including the strawbale technology center (2004), and an early childhood development center (2005).

### *Educational Opportunities in Sustainable Technologies*

The Model Home, constructed through a partnership between AIHI and the local Housing Authority also advanced the types of technologies applied in projects. Based on the results of student research, building systems such as insulated concrete forms, structural insulated panels, and in-floor radiant heating were incorporated into the project. Students gathered valuable experience working with and installing new and advanced sustainable building technologies. Multi-disciplined teamwork and leadership also played important roles in the construction of the Model Home as students were given the chance to take turns leading parts of the project.

Social and cultural experiences are imbedded within construction projects to enhance the student's educational experiences. The unique opportunity offered by the AIHI program allows students to develop technical knowledge and hands on experience with construction and sustainable technologies, in addition to providing a cultural dimension enhancing students' global awareness and sensitivity. Popular activities include attending the Native American Pow-Wow over the 4<sup>th</sup> of July weekend, back-country tours, art exhibits and history lessons.

The Model home also provided an excellent training ground for workers of the Northern Cheyenne Housing Authority (NCHA). University partners commit to two weeks of construction, thereby leaving the project at substantial completion. The NCHA had agreed to complete the project by hiring and training tribal members, many of which did not have prior construction experience. In addition to receiving basic training in carpentry and finishing trades, NCHA employees were exposed to both high and low-tech sustainable technologies.

### *Partnerships*

Through continued interest by both the academic and the tribal communities, a formal Cooperative Agreement was formed and solidified on July 1, 2003. The entities agreed to "engage in cooperative educational research and outreach activities for the mutual benefit." The activities discussed within the agreement include faculty and student exchanges, seminars,

workshops, courses, conferences, community outreach projects, and collaborative curriculums<sup>11</sup>. This document clearly outlines the roles of the institutions, and has since been recognized by funding sources as a positive indicator of the strong collaborative relationships that exist between Penn State University, University of Washington and Chief Dull Knife College.

In addition to straw bale building construction, a new branch of service to explore art in native cultures, Youth Restoration Art Project (YouthRAP), was formed to enhance the AIHI program. Through art, youth and students explore issues of identity, landscape and civic engagement while designing and constructing communal spaces on the reservation<sup>2</sup>. This program has helped to broaden the impact of AIHI on the reservation, and also create more robust opportunities for the arts and architecture faculty to seek funding sources for projects.

### *Research*

The AIHI program has been instrumental in providing applied topics for graduate research and, thus far, has resulted in two master's thesis. The research has helped educators to better understand the local housing conditions and circumstances which have perpetuated the housing shortage on American Indian reservations<sup>3</sup>, and how to deliver affordable, energy efficient and high-quality housing that reflects the specific traditions and values of the local tribe by addressing issues of culture, energy efficiency, cost, climate and constructability<sup>9</sup>. Further graduate research is in progress with a possibility of producing three additional master's thesis reports and two doctoral dissertations.

## **FUTURE GOALS**

AIHI looks to further strengthen relationships between the academic and tribal communities and strives to create and implement sustainable and culturally appropriate solutions through educational experiences.

### **Phase 3: Implementation: Expanding Educational Experiences**

The relationships and partnerships developed throughout Phase 2 have had significant impact on the plans and actions for Phase 3. More developed relationships and communication has provided a deeper understanding between the universities and the tribal college. The Technology Center that is to be completed in 2004 will serve as an educational home for AIHI within the community. The Technology Center will address vital educational needs in the community by developing skilled labor and providing a facility to conduct housing counseling and home maintenance education programs<sup>4</sup>.

One goal of Phase 3 is to emphasize the importance of sustainable principles in engineering curricula, specifically the AIHI aligned course, and its relationship to native cultures, community history, cultural sensitivity and global awareness. Student will gain cultural knowledge to enhance their understanding of the world around them. In addition, a co-aligned course at the tribal college will be designed to allow students from the reservation to learn about sustainable principles and technologies and work alongside students from the universities in the project construction to create a better facilitated cross-cultural exchange.

Further graduate research will be conducted to increase environmental awareness and principles of sustainability in engineering education by lessons learned from native cultures. The research proposes to provide an educational and cultural exchange for students both on and off the reservation through a dual learning experience highlighting sustainability, environmental and cultural awareness, sensitivity, and versatility.

## **CONCLUSION**

Environmental awareness and sustainable principles can be incorporated into many educational settings, both inside and outside of the classroom. Service learning and public scholarship courses can enhance engineering education through appropriate cultural exchanges that emphasize sustainable technologies and practices, cultural sensitivity and global awareness. Partnerships with local communities can offer academic institutions tremendous educational opportunities, while at the same time, fostering the deployment of appropriate sustainable technologies in native communities. Hands-on projects and research can stem from mutual interests framed within educational formats. The American Indian Housing Initiative offers engineering educators a model for incorporating service learning and public scholarship into engineering curricula through cross-disciplined, cross-cultural exchanges of knowledge and experience. AIHI helps to provide students with opportunities to explore technical knowledge and hands on experience through teamwork, leadership and problem solving. As a result, progress can be made towards the development of world class engineers through of education in sustainability, cultural sensitivity, social responsibility and global awareness.

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## **BIBLIOGRAPHY**

1. "The American Indian Housing Initiative, Mission and Goals" Penn State University, University Park, 2002.
2. "Beyond Boundaries, Creating Connections: YouthRestoration Art Project(RAP), A Northern Cheyenne Community Arts & Design Program," The Pennsylvania State University, University Park, 2003.
3. Bisko, Kathelene. "Implementing 'Self-Determined' American Indian Housing: How Well Does the Current Policy Approach Address Housing Needs on The Northern Cheyenne Reservation," Penn State University, University Park, 2003.

4. "Chief Dull Knife Feasibility Report: Community Facilities Grant Application," Tribal College Initiative, USDA Rural Development Montana. 2003.
5. "Environmental Engineering at Penn State University," College of Engineering, Penn State University, University Park, 12/2/03. "Welcome" website: <http://www.engr.psu.edu/ce/Divisions/enveng/index.htm>
6. "Environmental Systems Engineering & Geo-Environmental Engineering," College of Engineering, Penn State University, University Park, 12/2/03. "What We're About" website: <http://www.egee.psu.edu/environment/about.htm>
7. "Experimental Pedagogy in Sustainable Building Technologies, National Science Foundation Grant Application," College of Engineering, Penn State University, University Park, 2001.
8. Indian Health Services (2002) Statistical Database: ([www.ihs.gov/NonMedicalPrograms/IHS\\_Stats/IHS\\_HQ\\_Publications.asp](http://www.ihs.gov/NonMedicalPrograms/IHS_Stats/IHS_HQ_Publications.asp)).
9. Kocak, Fulya. "A 'Whole House Design Process' for the Northern Cheyenne," Masters Thesis in Architectural Engineering, Penn State University, University Park 2003.
10. National American Indian Housing Council Department of Research & Tiger Research (2001) "Too Few Rooms: Residential Crowding in Native American Communities and Alaskan Native Villages," Cooperative Agreement H-21257-RG with U.S. Department of Housing and Urban Development.
11. Riley, D., Palleroni, S., Wing, S., Rios, Little Bear, R., Wertman, B., "Cooperative Agreement between Chief Dull Knife College and Penn State University and University of Washington." 7/1/2003.
12. Riley, D., Workman, E. "Applied Green-Building Technologies: An Interdisciplinary Public Scholarship Course," Proceedings of the 2003 ASEE Annual Conference and Exposition.
12. "Student Reflections," AIHI Course Assignment. Penn State University, University Park, 2003.
13. "The World Class Engineer," The Leonard Center: for the Enhancement of Engineering Education, Penn State University, University Park, 12/1/03. website: <http://www.engr.psu.edu/LeonhardCenter/eec/wce.htm>

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