Alternative Building Strategies: Building Community Solutions for Native Nations with Straw Bale Construction

Laura Bartels

GreenWeaver Inc.

www.greenweaverinc.com

Greener Homes National Summit

HUD-ONAP

Denver, Colorado

Sept, 2011

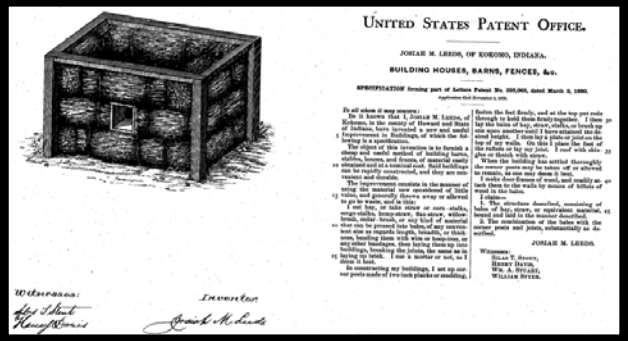
Anasazi Dwelling
Utah

Straw Bale Building

An American invention older than jazz

Straw bale building began in the late 1800's after the invention of the baling machine.

The first U.S. patent on bale building was in 1880.



UNITED STATES PATENT OFFICE.

JOSIAH M. LEEDS, OF KOKOMO, INDIANA.

BUILDING HOUSES, BARNS, FENCES, &c.

Adoption Across a Wide Spectrum

Photos Darcy Donovan and © Todd Winslow Pierce

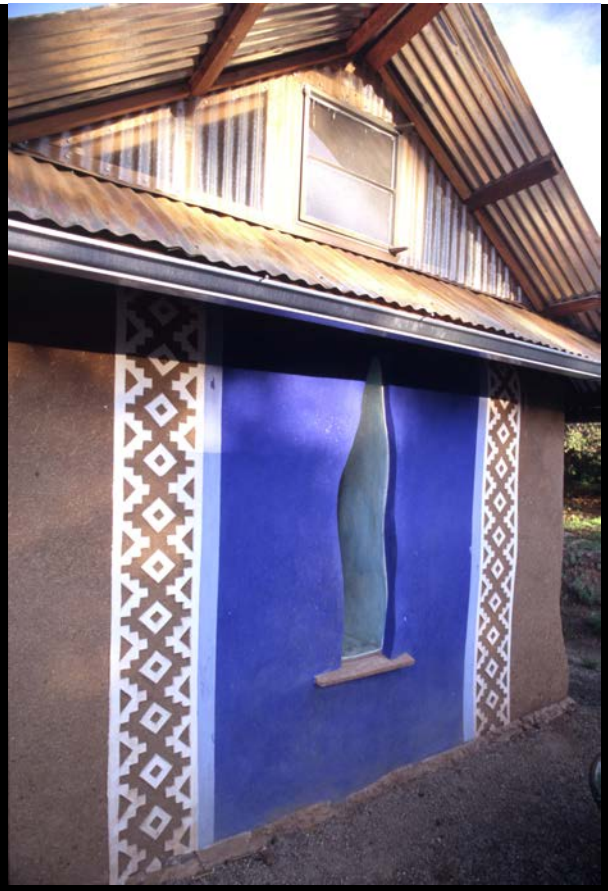
Springs Preserve, Las Vegas

- Achieved LEED Platinum using straw bale and rammed earth
- Winner, High Performance Building Award, Sustainable Buildings Industry Council

Photo © Luchessi Galati Architects, Inc.

Schools Choose Straw Bale to Reduce Cost and Energy Use and Offer Healthy Environment

Photo © Hord Coplan Macht



Upgrading Existing Buildings

Concrete home in Tucson retrofitted with straw bale and earth and lime plasters

Environmental and Energy Study Institute

EESI

Home || About EESI || Programs || Briefings || Publications || Employment || Support EESI

Speakers (l-r): Laura Bartels, Sandy Wiggins, Bob Gough, and David Eisenberg

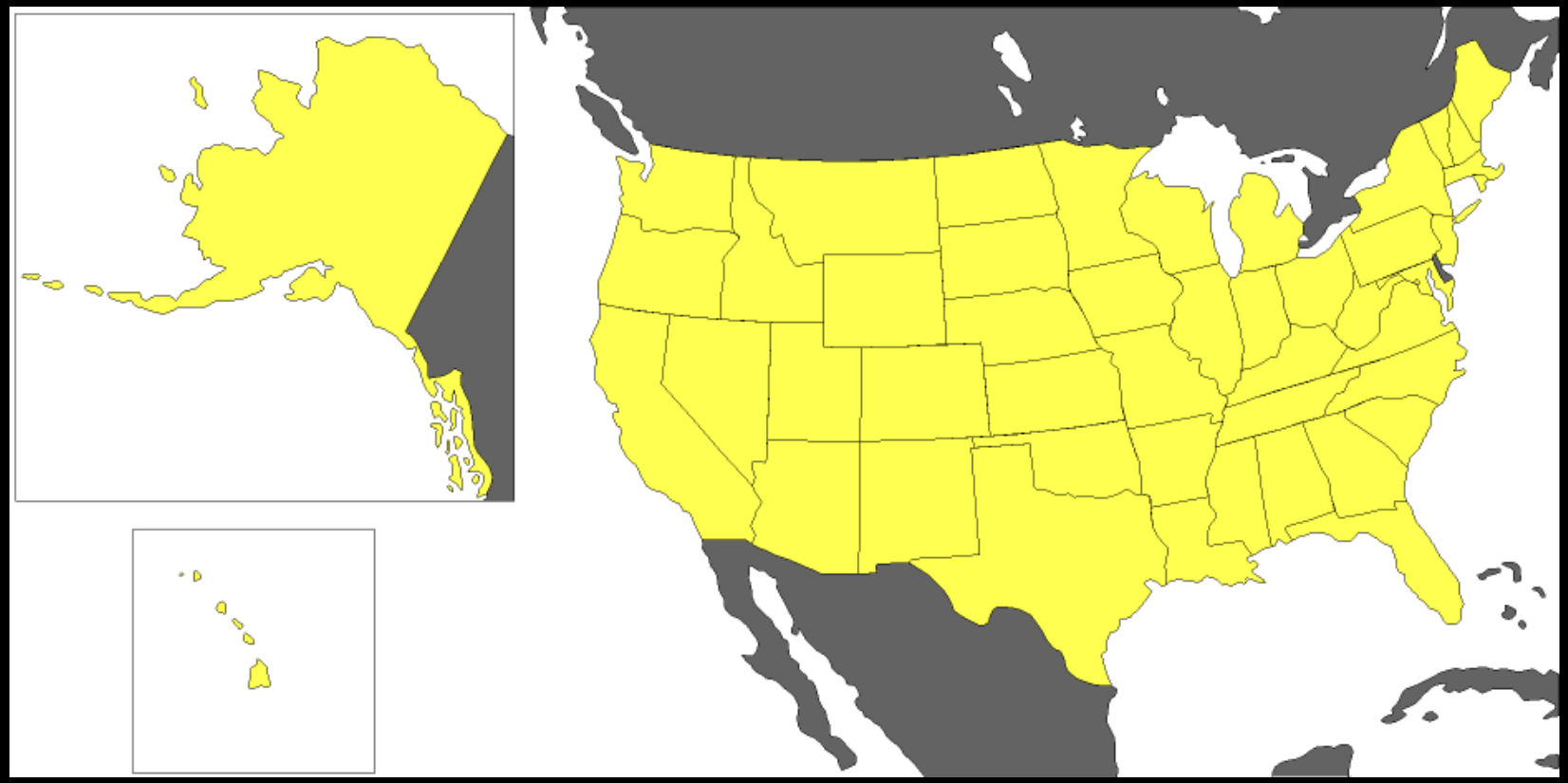
Straw-Bale Construction: Harvesting Its Potential As an Affordable and Energy-Efficient Building Strategy

Friday, June 20, 2008
10:00 a.m. - 11:30 a.m.
485 Russell Senate Office Building

On June 20, the **Environmental and Energy Study Institute** (EESI) hosted a briefing about straw-bale construction and how it can help address some of our most serious national policy challenges, such as record energy prices and unemployment, inadequate supply of affordable housing, the threat of climate change, and pressing needs in transportation and infrastructure funding. The modern building industry places heavy demands on the energy and transportation sectors. Straw is a locally-sourced, widely available, and renewable resource that builders, architects,

Modern Straw Bale Building

All 50 U.S. States currently have straw bale structures



It’s Not Just Us

Over 40 countries have straw bale structures

Including Argentina, Australia, Belarus, Belgium, Bulgaria, Canada, Chile, China, Croatia, Czech Republic, Denmark, Ecuador, England, Estonia, Finland, France, Germany, Greece, Guatemala, Hungary, India, Ireland, Israel, Japan, Korea, Mexico, Mongolia, Netherlands, Neutral Zone, New Zealand, Norway, Pakistan, Peru, Portugal, South Africa, Spain, Sweden, Switzerland, United States, Uruguay, Yugoslavia, Zambia

http://sbregistry.greenbuilder.com/

www.thelaststraw.org

Why the Growth?

"[Straw bale building] is a powerful strategy in creating energy and resource efficient buildings."

Charles R. Smith, Jr. AIA, LEED AP
Vice President, HOK
#1 Architectural/Engineering Firm,
Engineering News-Record, April 21, 2008

Santa Clarita, CA Transit Maintenance Facility, LEED Gold

Photo Courtesy of Bruce King, P.E.

A Resource to be Taken Seriously

- The amount of straw available annually is substantial- 125 to 177 million tons.
  (Source: USDA Economic Research Service)
- If half was available for building, it would create over 10 million 2,000 sf homes annually.
  (Source: Toolbase Services, NAHB Research Center)

ANNUAL HOUSING STARTS (1978-2007)

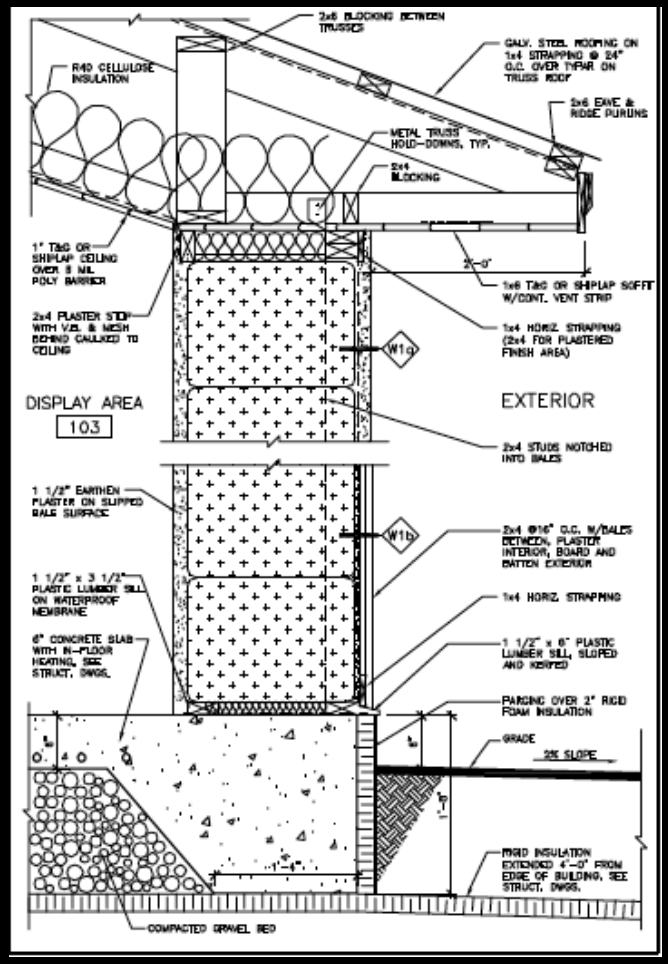
Year	Single-Family	Multifamily	Total
2007	1,045,900	309,200	1,355,200
2006	1,465,400	335,500	1,800,900
2005	1,715,800	352,500	2,068,300
2004	1,610,500	345,300	1,955,800
2003	1,499,000	348,700	1,847,700

Source: U.S. Census Bureau

That's 5 times the highest number of US annual housing starts in history.

Building With Baled Straw

- Uses baled straw (not hay)
- Straw is either structural or non-structural
- Plaster applied on both sides
- Well designed for moisture



Drawing courtesy of Chris Magwood

Structural Wall System

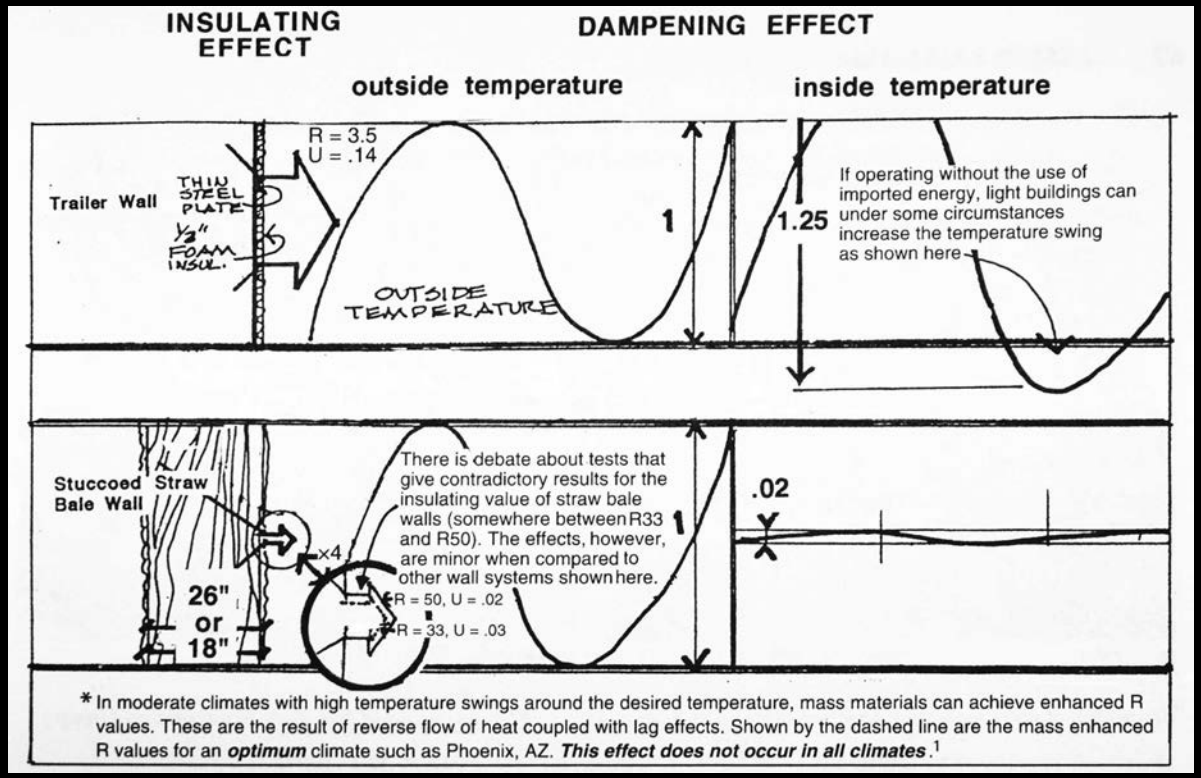
Non Structural Wall Systems

The Process

High Performance, Low Impact Building Envelopes First

- 2,700 square feet
- Temperatures to -30°F
- 4 foot average snow pack
- ➠ Heating and hot water $30/month
- ➠ Indoor temperature when unheated never below 55°F

INSULATION + MASS = COMFORT



HOME ENERGY RATING

Properties of Plastered Bale Walls

- Thermal
  - ORNL testing demonstrates R-value of 27 for 18” wall
  - CA Energy Commission allows R-value of 30 for plastered bale wall
  - Mass of plaster shown to enhance R-value of assembly
- Structural
  - Compressive, lateral and seismic testing demonstrate impressive capacity and that it is a nearly ideal seismic material
  - Plastered wall acts like a stress skin panel with optimal ductility
- Acoustic
  - Testing shows straw bale wall to be excellent sound barrier
- Fire
  - Assemblies meet 1- and 2- hour ASTM fire ratings

Embodied Energy of Materials

MATERIAL	Btu/lb.
Baled Straw	6,499
Stone (Local)	21,685
Concrete Block	24,388
Concrete	35,199
Lumber	67,696
Brick	67,696
Gypsum Wallboard	165,185
Particle Board	216,665
Aluminum (Recycled)	219,367
Steel (Recycled)	240,990
Plywood	281,658

MATERIAL	Btu/lb.
Mineral Wool Insulation	395,365
Glass	430,564
Fiberglass Insulation	820,524
Steel	866,534
PVC	1,895,615
Copper	1,911,832
Paint	2,526,565
Linoleum	3,141,298
Polystyrene Insulation	3,168,389
Carpet (Synthetic)	4,007,832
Aluminum	6,147,204

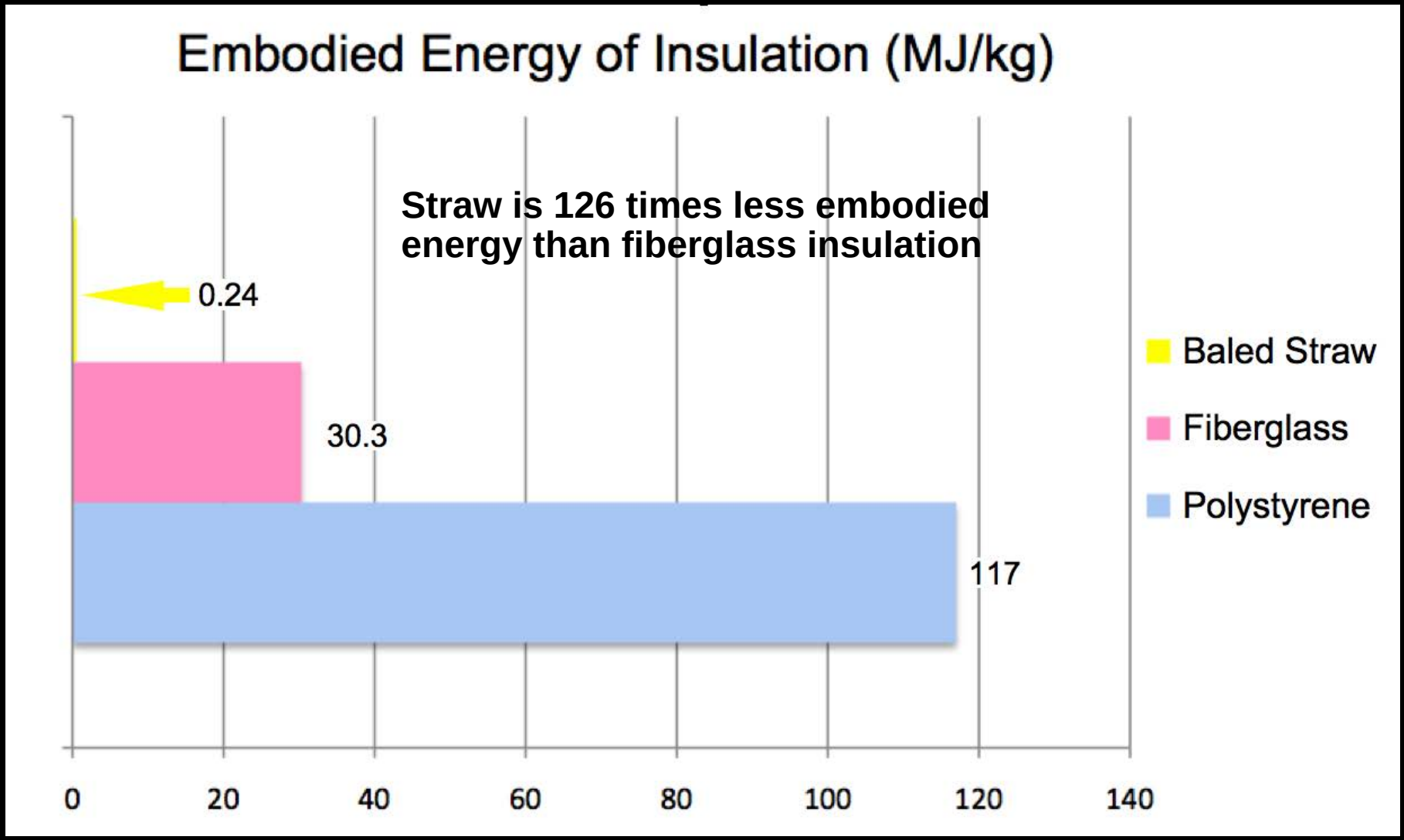
Sourece: Cole and Kernan

Embodied Energy of Materials

MATERIAL	Btu/lb.
Baled Straw	6,499
Stone (Local)	21,685
Concrete Block	24,388
Concrete	35,199
Lumber	67,696
Brick	67,696
Gypsum Wallboard	165,185
Particle Board	216,665
Aluminum (Recycled)	219,367
Steel (Recycled)	240,990
Plywood	281,658

MATERIAL	Btu/lb.
Mineral Wool Insulation	395,365
Glass	430,564
Fiberglass Insulation	820,524
Steel	866,534
PVC	1,895,615
Copper	1,911,832
Paint	2,526,565
Linoleum	3,141,298
Polystyrene Insulation	3,168,389
Carpet (Synthetic)	4,007,832
Aluminum	6,147,204

Sourece: Cole and Kernan



Meeting Energy Goals

- Low operating energy
  - Good thermal performance (reducing heating and cooling needs)
- Low embodied energy
  - Minimally processed
  - Local or regional, widely available
- Passive Survivability
  - Reduces likelihood of deaths from heat or cold in blackouts


CBS NEWS June 14, 2008 3:24pm

Death Toll From Calif. Heat Rises to 132

Death toll from sweltering Calif. heat wave tops 130, county coroners office says

Where Do Energy Dollars Go?

*The average is 70% to 80% according to “Dollars From Sense: Economic Benefits of Renewable Energy” 1995 U.S. DOE study. In Rural Communities & Indian Reservations it can be as high as 90%.

What if…

Mo of t M y
yed in th communi

It Can! Local Energy Efficiency & Renewable Energy Programs Can Create New Businesses & Services, New Green Jobs & Keep the Wealth Local.

Straw Bale Testing Programs

Straw Bale Building Code Development

www.Ecological Building Network.org
www.DCAT.net


NISSAN

Aging Gracefully

“All sustainability will be local”

- William McDonough

"Many traditional non-industrial building systems and materials were rejected because of labor intensity, not because they were inherently inferior or dangerous"

-David Eisenberg, DCAT

10 times less embodied energy

2.5 times more jobs created

50% less operating cost

Center for Maximum Potential Building Systems

Pozzolan calcrete block with mesquite sawdust block for insulation

vs.

Fired brick, insulation, wood, paint, bldg paper and gypsum

"Availability and Spatial Coincidence of Indigenous Building Materials", Pliny Fisk III, CMPBS

Sustainable Affordable Housing

Capital Cost +Operating Cost = Affordability

1. Energy
- **Reduce utility costs for heating and cooling**
- **Stretch energy assistance funding**
- **Reduce imports of higher cost building materials**

2. Employment & Economic Development
- **Create training & job opportunities**
- **Create value added businesses**

3. Health
- **Reduction of IEQ related medical expenses**
- **Reduction of absenteeism from work and school**

Sustainable Affordable Housing

Low Capital Cost +Low Operating Cost = Affordability

Job Creation with Local Resources

Photo © Dan Smith & Assoc., Architects

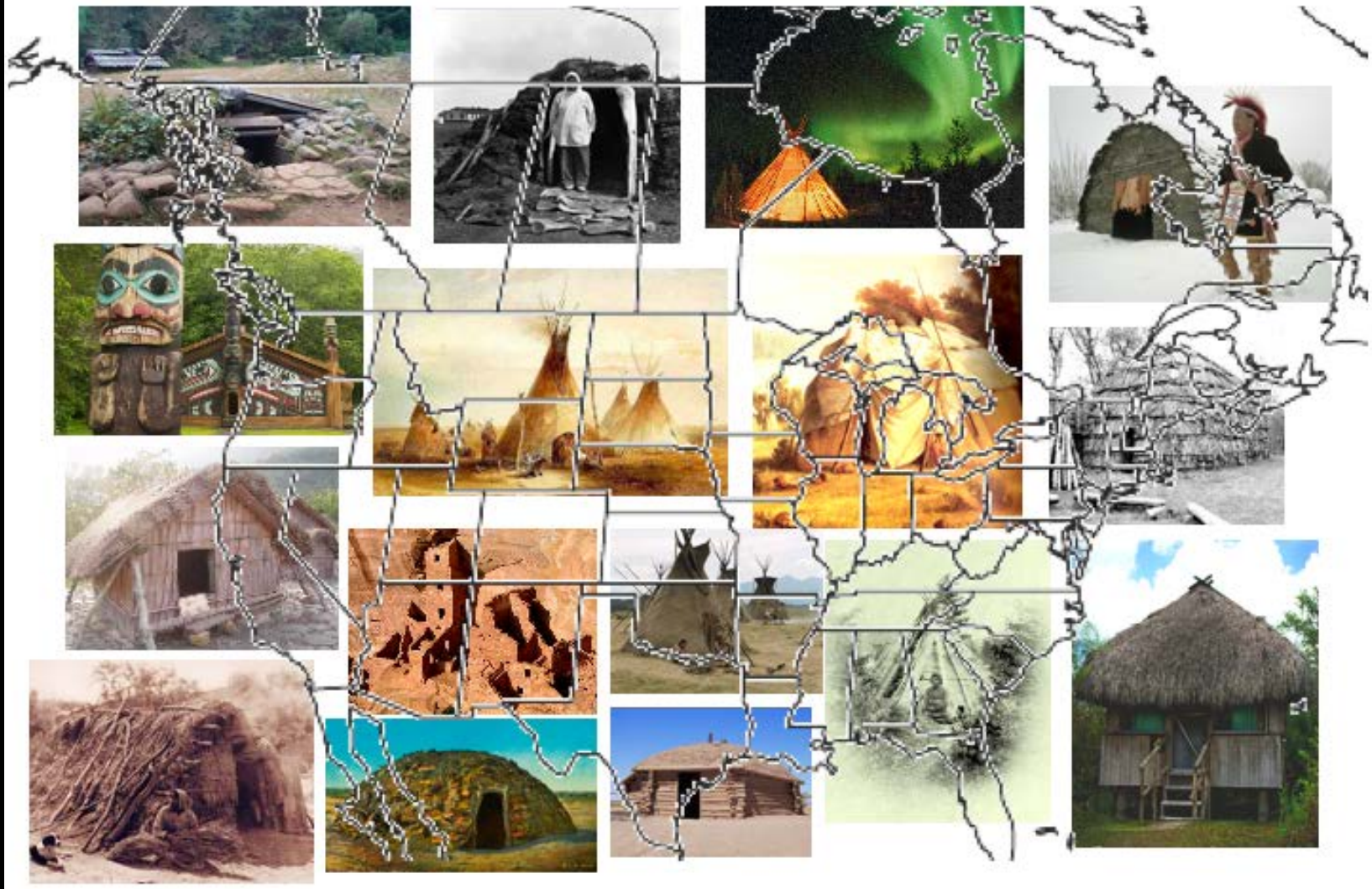
Cultural Appropriateness

Natural building encourages context based design, appropriate to the land as well as the social and cultural fabric of a community.

Millennia Long Tradition of Green Materials

Native Cultures are Seasoned Cultures

"Seasoned" means "rendered competent through trial and experience"



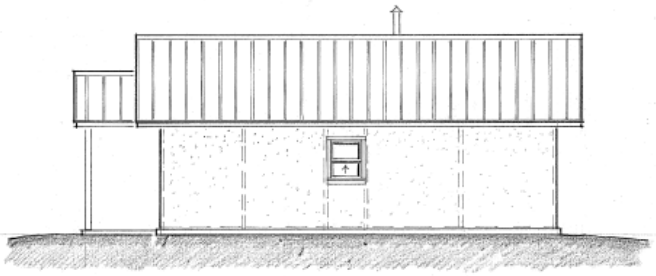
Tribal Straw Bale Building

- Rosebud
- Pine Ridge
- Turtle Mountain
- Northern Cheyenne
- Hopi
- Navajo
- Pinoleville
- And more…

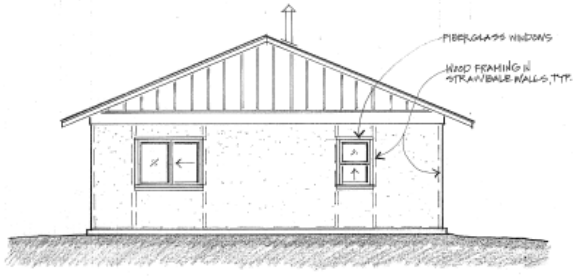
SAFE Homes Initiative

Sustainable Affordable Efficient Housing

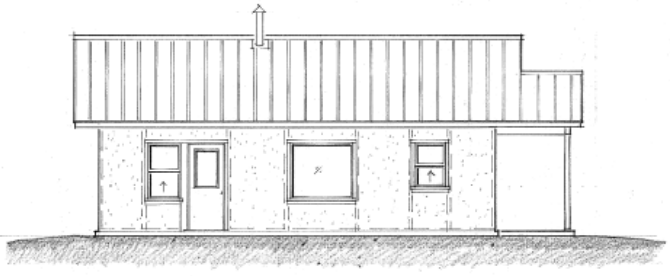
Intertribal COUP envisions a future that puts Tribes on the leading edge of true sustainability, a future in which Tribes can depend on their own natural resources and their own trained workforce to address the critical triple bottom line for Sustainable, AFfordable and Efficient Homes.



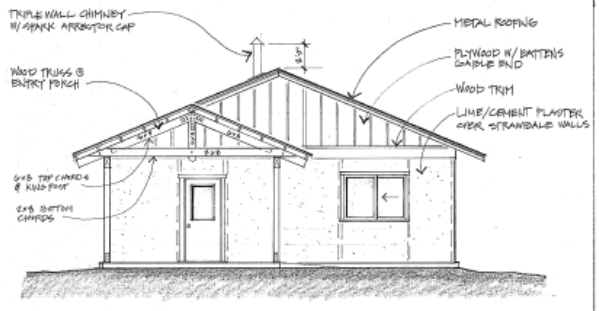
1/2 NORTH ELEVATION



2/2 WEST ELEVATION



3/2 SOUTH ELEVATION



4/2 EAST ELEVATION

ONE WORLD #DESIGN# ARCHITECTURE
Kelly Lerner, Architect
1484 East 13th Avenue
Spokane, WA 99202
509-688-8012
Internet
one-world-design.com

Proposed New Straw Bale Energy Efficient Office Building for the:

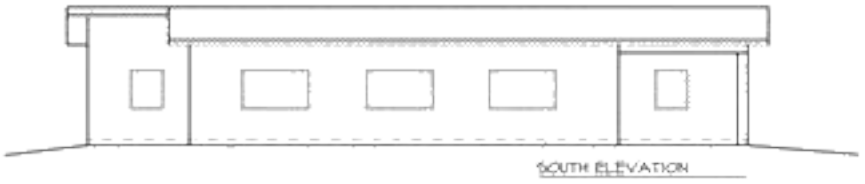
Sinte Gleska University Buffalo Lodge

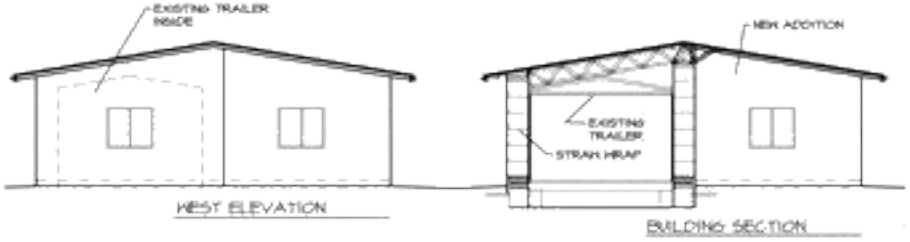
Sinte Gleska University Campus
Mission, South Dakota

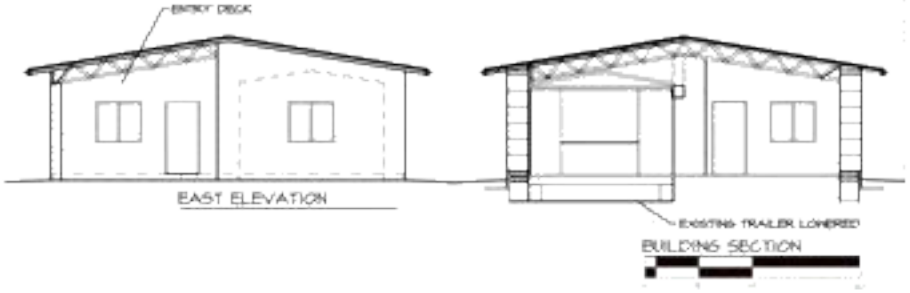
DATE	PURPOSE
6-1-05	Revised

2

COUP FEMA Trailer Wrap Design Concept







INTERTRIBAL
Council On Utility
Policy
COUP

U.S. DEPARTMENT OF THE INTERIOR
MARCH 3, 1849

GreenWeaver
INC

SINTE GLESKA UNIVERSITY ROSEBUD, SD
WOKSAPE
WOOHITIKA
WACANTOGNAKA
WOWACINTANKA
TM

ONE WORLD DESIGN
ARCHITECTURE

DCAT
DEVELOPMENT CENTER FOR APPROPRIATE TECHNOLOGY


Tatanka Oti ~ Buffalo Lodge
on the SGU Antelope Campus
Rosebud Sioux Reservation

OPEN HOUSE

August 26 and 27, 2010

Sinte Gleska University ~ Antelope Campus

East of Mission SD ~ Rosebud Indian Reservation

Get Details on Buffalo Art Contest

Try Your Hand at Earthen Plastering

INTERTRIBAL Council On Utility Policy's

Sustainable, Affordable, Future-proof & Energy Efficient

Straw Bale Model (S.A.F.E.) Home

SGU Buffalo Ranch Management Program Lodge

Sustainability in Housing ~ 2009/10

Straw Bale Building Initiative: Tatanka Oti

Buffalo Lodge Project for Tribal College Faculty & Students

Sinte Gleska University ~ Antelope Campus Rosebud Sioux Indian Reservation

Developed By

Intertribal Council On Utility Policy (COUP)

GreenWeaver Inc ~ Straw & Timber Craftsmen

Environmental Design Partners ~ One World Design Architecture

Development Center for Appropriate Technology ~ 3DE

Sinte Gleska University

Institute of Technologies ~ Buffalo Ranch Program ~ Art Institute

Oglala Lakota College Applied Science General Construction

United Tribes Technical College

American Indian Higher Education Consortium

Rosebud, Oglala, Turtle Mtn., Ft. Berthold, Flandreau Sante, Lower Brule, Yankton

With Support From

DOI ~ Office of Indian Energy and Economic Development

Rosebud Sioux Tribe ~ Sinte Gleska University ~ Intertribal COUP

DOE-TEP ~ Friends' PYM Indian Committee (Quakers) ~ UNCF

South Dakota Community Foundation ~ Greiner Family Foundation

COSBA ~ Untours Foundation ~ USDA-RC&D ~ Solar Energy International

Straw Bale Construction

Intertribal COUP S.A.F.E. Homes

"Tatanka Oti" Buffalo Lodge Project

Advantages of Straw Bale Construction

For the Home/Building Owner:

Cheap and easily accessible agricultural waste product

Provides super insulation (R-35 to R-40)

Low-embodied energy and energy efficient

Reduced heating and cooling needs and costs

Great aesthetics, beautiful homes

For the Community:

Locally grown, surplus, natural, renewable product:

Increase value of waste product to local agricultural producers

Local employment and sweat equity in construction and maintenance

Proven durability of material and reliability of technology:

More than 100 years of application in the Upper Great Plains

Resistant to high winds, tornadoes, earthquakes and fire

Great flexibility of design and easy to implement

INTERTRIBAL COUNCIL ON UTILITY POLICY

>>>> P.O. Box 224, Ft. Pierre, SD 57532 Phone: 605-280-7999 <<<<

President Patrick Spears < Prspears2@aol.com > Secretary Robert Gough < Gough.Robb@gmail.com

Treasurer Bill Schumacher< Billschumacher1@yahoo.com

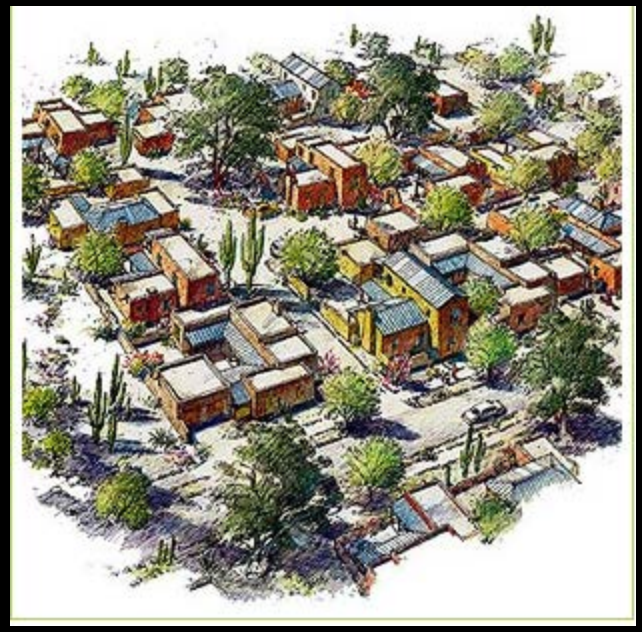
www.IntertribalCOUP.org

Pinoleville Pomo Nation
Prototype Straw Bale Homes

HEALTH

VITALITY

PROSPERITY



Healthy Communities

Sustainable & Sovereign

An appropriate response to past and future realities is to help to redevelop community self-sufficiency

Housing for Strong Communities

- local materials
- high performance (net zero energy)
- low impact
- healthy

A Multitude of Benefits

Straw Bale Construction has become a viable building system for a wide range of applications. Among its many crosscutting benefits it is:

- *Abundant*
- *A low-embodied energy material*
- *Able to create highly energy-efficient buildings*
- *An added value market for farmers*
- *A vehicle for green tech job and business creation*
- *Ideal for affordable and self-help housing*
- *A contributor to energy security*
- *Climate-beneficial building system*
- *An affordable way to add beauty and customization*

Credit: Development Center for Appropriate Technology

"…the economic, job-creation, and health benefits of undertaking this shift are enormous, while the financial and environmental costs of not acting are alarming."

- Guy Dauncey

GreenWeaver Inc.
Services

- **Green and Natural Building Workshops**
- **Educational Presentations**
- **Facilitation**
- **Program and Curriculum Design**
- **Architectural and Technical Consulting**
- **Hands On Learning**

www.greenweaverinc.com

Laura Bartels
President
520 S. Third St, Suite 5
Carbondale, CO 81623
laura@greenweaverinc.com
970--379-6779