

**Towards Greener Pastures  
Sustainable Housing Options for America's Rural Poor**

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## **Introduction**

One of the most challenging aspects of poverty is countering the prevalence of substandard housing that plagues impoverished communities. This nation includes many architectural wonders and feats, however, there have been very few sustainable and quality housing developments targeted towards the low-income population. The poor frequently reside in houses that the general public would think are uninhabitable, but have no alternative option. Part of the problem is due to the lack of architectural involvement. The status quo for low-income housing often equates cheaply built, mass-produced, one-size fits all housing solutions, failing to address the diverse array of circumstances and needs.

Architecture, on the other hand, purports customization and designing for particular needs, sites and climates. Unfortunately, architecture has long been a service for the elite, making it a rather top-shelf luxury. But with today's shortcomings in housing, new innovative and sustainable design solutions emanating from the architectural community are desperately needed. Solutions that architects seem to be the most qualified to provide.

Although most architects and much of the housing industry, fail to address the housing problems in impoverished communities, a few architects and housing advocates recognize the need for a new approach to creating housing options for the poor and are responding with innovative and exciting solutions. Examined in the following pages are two potential solutions: the use of straw-bale construction on Indian reservations, and attempts to create a new generation of mobile homes to respond to the needs of communities in the rural South. Both present sustainable designs that include environmental, economic, and social considerations, a feat that has been difficult to accomplish in most affordable housing projects. The two presented projects are not the only architectural housing initiatives focusing on serving the poor, as other efforts are emerging and offering a glimpse of hope in what architecture and sustainable housing can do for the underserved.

## **Inadequate Housing in the United States**

Wealthy and middle-class Americans are well aware of social injustices and the need for basic shelter abroad, but seem fairly oblivious to the prevalence of inadequate housing here in the United States. Many examples of these housing inadequacies are confined to inner urban housing projects or impoverished rural communities, although upon closer examination, such housing may be found in one's own community or county. The harsh reality of poor housing conditions is that these disparities are often overlooked or ignored because they remain in socio-economic or geographical areas that tend to be out of sight of the general public. Many of America's poorest residents are concentrated in rural areas that are persistently in poverty. According to the 2000 Census, 94% of the poorest are located in rural America.<sup>1</sup> Generally in non-metropolitan, rural areas, unemployment is higher while education and social services are limited, providing little means to counteract the cyclical patterns of poverty.<sup>2</sup> The poorest rural areas are consistently found in central Appalachia, the Lower Mississippi Delta, Mexican border settlements, and Native American lands.<sup>3</sup> Many of these communities have persisted without little notice from the general public, occasionally making prime time news upon near disaster situations.

In the wake of Hurricane Katrina, it became apparent that prior to the storm's devastating damage, New Orleans and much of the rural South was enduring serious housing challenges associated with the high level of poverty in Louisiana, Mississippi and Alabama. According to the 2000 census, Mississippi had the second highest percent of the state population living below the poverty level, while Louisiana had the third highest.<sup>4</sup> Much of this poverty is attributed to the historical roots of racism and socio-economic disparities of the South, resulting in "inadequate employment opportunities, and poor

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<sup>1</sup> The Housing Assistance Council, "Poverty in Rural America," [http://www.cohhio.org/pdf/online\\_library/HousinginRuralAmerica\\_2.pdf](http://www.cohhio.org/pdf/online_library/HousinginRuralAmerica_2.pdf) (accessed October 24, 2009)

<sup>2</sup> Robert E. Pierre, "Poverty Tightens Grip On Mississippi Delta," Washington Post, July 17, 2004, <http://www.washingtonpost.com/wp-dyn/articles/A56070-2004Jul16.html>. (accessed December 8th, 200).

<sup>3</sup> Ibid.

<sup>4</sup> U.S. Census Bureau, "Income and Poverty in 1999: 2000," American Fact Finder Fact Sheet Census 2000 Summary File 3, [http://factfinder.census.gov/servlet/GCTTable?\\_bm=y&-geo\\_id=01000US&-ds\\_name=DEC\\_2000\\_SF3\\_U&-\\_lang=en&-redoLog=false&-mt\\_name=DEC\\_2000\\_SF3\\_U\\_GCTP14\\_US9&-format=US-9&-CONTEXT=gct](http://factfinder.census.gov/servlet/GCTTable?_bm=y&-geo_id=01000US&-ds_name=DEC_2000_SF3_U&-_lang=en&-redoLog=false&-mt_name=DEC_2000_SF3_U_GCTP14_US9&-format=US-9&-CONTEXT=gct) (accessed November 14, 2009).

quality public schools,” and thus hindering the ability of southern residents to obtain decent and affordable housing.<sup>5</sup> In the Lower Mississippi Delta, it is reported that 1% of homes lack plumbing and kitchens, while 5% remain without telephone service.<sup>6</sup> Crowding is also a problem, with 9.3% of homes in the region declared as over-crowded.<sup>7</sup> Many of the poor housing conditions are significantly more prevalent in African American homes, with more than one-third of the African American residents living below the poverty line in this region.<sup>8</sup>

Similar destitution and housing problems occur in agricultural based southern communities, particularly in regards to the housing needs of migrant workers. Agricultural areas in central Florida and along the Atlantic coast include a large population of migrant workers, predominately from Mexico, who are hired to work on farms and orchards. These families subsist on meager incomes of \$10,000 or less, consequently what they can afford is to live in are overcrowded, dilapidated trailers.<sup>9</sup> This arrangement is neither just nor healthy. A study conducted by Wake Forest University School of Medicine found overcrowded migrant housing in North Carolina to be at-risk environments for exposure to disease and toxins, while the density of people can be psychologically disruptive to inhabitants.<sup>10</sup> Additionally, trailers, especially older ones, are structurally vulnerable to storm damage, a hazardous housing arrangement in a climate that frequently experiences storms and hurricanes. Despite the fact that this matter deals with non-citizens, these housing conditions are intolerable and require significant attention and upgrading.

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<sup>5</sup> “Racial and Ethnic Tensions in American Communities: Poverty, Inequality, and Discrimination – Volume VII: The Mississippi Delta Report,” U.S. Commission on Civil Rights, February 2001, <http://www.usccr.gov/pubs/msdelta/ch1.htm> (accessed December 17, 2009).

<sup>6</sup> The Lower Mississippi Delta includes parts of Arkansas, Louisiana, Mississippi and Missouri. “Housing in the Lower Mississippi Delta,” Housing Assistance Council, April 2005. <http://www.ruralhome.org/storage/documents/missdelta.pdf> (accessed December 17, 2009).

<sup>7</sup> Ibid, 2.

<sup>8</sup> “Housing in the Lower Mississippi Delta,” Housing Assistance Council, April 2005. <http://www.ruralhome.org/storage/documents/missdelta.pdf> (accessed December 17, 2009).

<sup>9</sup> Design Corps Projects, “Farmworker Housing Program,” Design Corps, <http://www.designcorps.org/Projects/Housing.htm> (accessed October 20, 2009)

<sup>10</sup> A.L. Gentry et al., “Housing Quality Among North Carolina Farmworker Families,” *Journal of Agricultural Safety and Health* 13 no. 3 (2007): 323-337.

Beyond the Southern concentrations of poverty, multiple Native American reservations include some of the worst housing conditions in the U.S. These deplorable conditions are often comparable to those in third world countries.<sup>11</sup> The Census Bureau estimated the American Indian and Native Alaskans (AINA) population to be here are 3,083,434 in 2008.<sup>12</sup> About half of the AINA population resides on Indian lands and reservations with increasing numbers of Native Americans returning to reservations in the past decade.<sup>13</sup> Although, the explanation for these disparities is historically complicated, the poverty is undeniable. The last census found the poverty rates on reservations to be two to three times higher than the national rate. As a consequence of locality, some reservations experience more severe rates of poverty because of isolation from economic opportunities and employment. On these reservations are found the worse cases of housing conditions. Only eight years ago did the Senate Indian Affairs Committee find nearly 90,000 Indian families homeless or under-housed.<sup>14</sup> A study conducted by the Coalition on Indian Housing and Development found 40% of Native Americans living in overcrowded or physically inadequate housing conditions, nearly six times larger than the national average.<sup>15</sup> Furthermore, the study estimates 200,000 homes are needed to suffice current waiting lists, with thousands more additionally needed to fulfill housing needs for those families not represented by waiting list figures.<sup>16</sup> Again, old mobile homes are a common housing arrangement on the reservation and are frequently in disrepair, but still remain inhabited due to few alternate options.

The above are just three examples of rural American housing deficiencies and what many would consider social justice issues. The United States also includes some 670,000 homeless people and urban housing projects offer a host of problems in desperate need of social and architectural aid in providing

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<sup>11</sup> Roberta Youmans, Federal Housing Finance Board, "*Native American Housing Needs and Proposed Recommendations.*" Background paper presented to the Millennial Housing Commission, 2002, p. 4.

<sup>12</sup> U.S. Census Bureau, "Table 3: Annual Estimates of the Resident Population by Sex, Race, and Hispanic Origin for the United States: April 1, to July 1, 2008," (NC-EST2008-03), Population Division, May 14, 2009

<sup>13</sup> Roberta Youmans, Federal Housing Finance Board, "*Native American Housing Needs and Proposed Recommendations.*" Background paper presented to the Millennial Housing Commission, 2002, p.2.

<sup>14</sup> "A Quiet Crisis: Federal Funding and Unmet Needs in Indian Country," U.S. Commission on Civil Rights, July 2003, <http://www.usccr.gov/pubs/na0703/na0204.pdf>, (accessed December 22, 2009), 50, 111.

<sup>15</sup> Roberta Youmans, Federal Housing Finance Board, "*Native American Housing Needs and Proposed Recommendations.*" Background paper presented to the Millennial Housing Commission, 2002, p. 4-5.

<sup>16</sup> *Ibid*, 4.

adequate housing. Isolation and ignorance have allowed such destitution to quietly resume, often unnoticed by the general public. Architecture professor and advocate Sergio Palleroni, describes the paradigm, writing, “I often compare the situation of living in the United States to being in the eye of the storm.” At the center, Palleroni contends everything deceptively appears to be calm and peaceful. Stepping outside the confines of suburbia and into these destitute communities, is akin to stepping outside the calm and into the storm and realizing the reality of American poverty.<sup>17</sup> Luckily the storm’s magnitude is slowly becoming more apparent to the rest of the country and inspiring action on the part of a few architects and housing advocates.

### **Sustainable Housing Solutions to American Rural Housing Inadequacies**

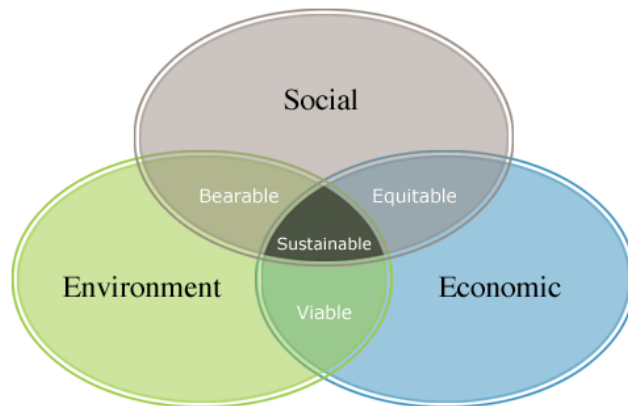
The challenge to provide sustainable homes to the underclass is very complicated and has been avoided for the most part by architects and “green” builders due to the lack of financial incentives and inexperience in this type of project. Dedicating efforts towards serving the lower class is rarely lucrative and many architects are not willing to direct their work towards such a venture when they have the opportunity to pursue more high-end fee-based work.<sup>18</sup> The desire to lend a hand and the prospect of generating real improvement in these struggling communities has inspired a few architects and advocates have to pursue such projects and to devise housing solutions that make sustainability accessible to the underclass. Fortunately a few of the developed projects present real potential to provide alternatives to the substandard housing that plagues these communities. Two specific projects are examined in the following pages, demonstrating how housing is being adapted to fit the needs the American rural poor without sacrificing affordability, sustainability or social justice. The first case study focuses on the overwhelming need for adequate housing on Native American reservations in the Midwest and how one particular

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<sup>17</sup> Sergio Palleroni, “Building Sustainable Communities and Building Citizens,” In *Expanding Architecture: Design as Activism*, ed. Bryan Bell and Katie Wakeford [New York: Metropolis Books, 2006], 275.

<sup>18</sup> Amy Ress, email correspondence with author, January 4, 2010.

housing initiative is responding to this problem. The second case study examines the development of sustainable alternatives to the mobile home and the potential for pre-fabricated housing systems to help to provide for various housing needs in Southeastern United States. The two projects are evaluated for their sustainability. The definition of “sustainability” used in this evaluation is based on the Triple Bottom Line standards, which maintain that in order for something to be truly sustainable, it must encompass environmental, economic and social components.



**Figure 1:** A diagram of the Triple Bottom Line Concept of sustainability

Each case presents different community needs and parameters while demonstrating two very different housing solutions that can be adapted to provide dignified and sustainable housing for some of America’s most needy individuals.



## Case Study: Native American Housing and Straw Bale Solutions

Tucked away on remote reservations, many native communities remain in serious poverty and are bleakly reputed to be “the poorest and most poorly housed population in America.”<sup>19</sup> Due to historical injustices, failed government programs, and isolation from economic opportunities, many reservations struggle in the 21<sup>st</sup> century. One of the most impoverished Indian reservations is the Pine Ridge Reservation in South Dakota, home to the Oglala band of the Lakota Sioux Tribe. The Oglala are one of seven sub-tribes belonging to the Lakota Sioux Tribe, whom once inhabited the Black Hills and surrounding plains. Renowned Oglala leaders, such as Chief Red Cloud and Crazy Horse fought with other honorable Sioux warriors to defend their Tribe and protect their territory from the imposing U.S. government throughout the 19<sup>th</sup> century. Eventually, these warriors proved to be no match against U.S. troops and were forcibly relocated to less desirable lands in order to satisfy the interests of the “white man.”

The Fort Laramie Treaty in 1868 created the Great Sioux Reservation that allocated the plains Indians with 60,000,000 acres of land, coaxing the Sioux Indians to surrender their nomadic ways for a more sedentary and “civilized” lifestyle.<sup>20</sup> Over the following fifty years the vast reservation was continually reduced as the federal government opened the Indian territory to homesteading and later confiscated the Black Hills upon discovering gold there in 1876.<sup>21</sup> In 1889 Pine Ridge Reservation was established when the remaining Sioux territory was divided into five smaller reservations, the Oglala receiving a tract of land nearly the size of Connecticut in the southwest corner South Dakota.<sup>22</sup> Although the reservation’s acreage appears to be a generous gift, it was a pitiful substitute and was considered a desolate and barren land. Disgruntled and starving, the Sioux were met with force from the government,

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<sup>19</sup> Sergio Palleroni and Christina Eichbaum Merkelbach, *Studio at Large: Sustainable Design Solutions from the Pacific Northwest* (Seattle: University of Washington Press, 2004), 99.

<sup>20</sup> Ellen Dockery, “About the Pine Ridge Reservation,” Impacts of Resource Development on Native American Lands Case Study Carleton College, [http://serc.carleton.edu/research\\_education/nativelands/pineridge/reservation.html](http://serc.carleton.edu/research_education/nativelands/pineridge/reservation.html), (accessed January 2, 2010).

<sup>21</sup> Ibid.

<sup>22</sup> Ibid.

with the Wounded Knee massacre occurring on the edge of the Pine Ridge territory in 1890, resulting in death of 300 unarmed Lakota men, women and children by U.S. troops.<sup>23</sup>

The following decades were marked by less violence but the Oglala residents of Pine Ridge reservation continued to live in dire poverty with little improvement. Out of frustration, an armed rebellion attempt by Indian activists at the historic site of the Wounded Knee massacre occurred in 1973. The event served to expose the conditions of the reservation to the American public and received considerable national attention.<sup>24</sup> Additionally, in the 1980's Shannon County, the county in which most of Pine Ridge lies, was named the poorest county in the United States. The data produced by the 1990 census supported this title and eventually attracted the attention of the white house, with a visit by President Clinton to Pine Ridge in 1998. When the median income was estimated at \$2,600 on the reservation.<sup>25</sup> Clinton assured, "Give us your vision, we will work to attain it," but unfortunately the President's promises have not materialized substantially, marking a long succession of broken promises<sup>26</sup>

Today, the conditions of Pine Ridge have not improved considerably since the 1980's and 1990's. Although the Bureau of Indian Affairs (BIA) and other government programs have attempted to alleviate the poverty on Pine Ridge, these efforts have not appropriately addressed the reservation's problems and have proven to be unsuccessful. Gauging the current economic and social circumstances on the Pine Ridge reservation in an accurate manner has proved to be difficult. Discrepancies have emerged from census data and figures generated by the government and are thought to be inaccurate and unreliable depictions of the conditions on the Pine Ridge reservation as well as other Indian reservations.<sup>27</sup> For example, population estimates generated by the 2000 Census were recently proven to be inaccurate. The government now recognizes Pine Ridge to have more than 28,000 residents rather than the originally

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<sup>23</sup> Lori Liggett, "The Wounded Knee Massacre: December 29, 1890," Bowling Green State University, American Culture Studies Program, 1998, <http://www.bgsu.edu/departments/acs/1890s/woundedknee/WKmscr.html> (accessed January 2, 2010).

<sup>24</sup> John William Sayer, *Ghost Dancing the Law: The Wounded Knee Trials*, (Cambridge: Harvard University Press, 2000), 4.

<sup>25</sup> Roberta Youmans, Federal Housing Finance Board, "*Native American Housing Needs and Proposed Recommendations*." Background paper presented to the Millennial Housing Commission, 2002, p. 4.

<sup>26</sup> "A Strategic Plan for Implementation of Pine Ridge Shared Visions Housing Initiative," Oglala Sioux Tribe Partnership for Housing, Inc., 2000, <http://archives.hud.gov/reports/pineridge/mou.pdf>. (accessed December 23, 2009).

<sup>27</sup> Bambi Kraus, "Wealth, Success and Poverty in Indian Country," *Poverty & Race*, May/June 2001, [http://www.prrac.org/full\\_text.php?text\\_id=63&item\\_id=1778&newsletter\\_id=56&header=Poverty+%2F+Welfare](http://www.prrac.org/full_text.php?text_id=63&item_id=1778&newsletter_id=56&header=Poverty+%2F+Welfare), (accessed Dec. 20, 2009).

reported population estimate of 15,000. “We have been dealing with inaccurate census numbers for years,” insists Jim Berg, executive director of the Oglala Sioux Lakota Housing.<sup>28</sup> Self-reporting and surveying disorganization as well as a lack of official records have contributed to these discrepancies. Although statistics calculated by the government and by individual Tribes may differ to some degree, the disparity occurring on the reservations is still apparent in the figures. Clearly this demonstrates a need for further intervention and assistance. Furthermore, a large proportion of the data regarding Pine Ridge was collected for the 2000 census and is ten years old and is now considered outdated. Nonetheless, the below housing conditions and statistics still convey the disparities on Pine ridge and the desperate need for adequate housing.

A recent tribal charter produced by Oglala Sioux Housing Committee described the housing conditions on Pine Ridge as “unsanitary, unsafe, and overcrowded dwelling accommodations,” with multiple grievances demonstrating the deplorable state of the reservation.<sup>29</sup> A lack adequate plumbing compromises the sanitation of some reservation homes while some homes continue to be inhabited with no plumbing at all.<sup>30</sup> Additionally, Black Mold infestations have created further sanitation and health problems. The tribe’s Health and Human Services Department has found mold infestations in 55% of the reservation’s homes. Half of the reported homes have severe mold outbreaks and have received the highest classification level of contamination.<sup>31</sup> Posing health hazards, such serious cases of mold may require the condemning of a home. Unfortunately some families have no choice but to tolerate the mold and dysfunctional plumbing, as they are unable to afford alternative housing.

The safety of reservation homes is another serious concern, particularly due to severe winter weather, with temperatures dropping well below zero while accompanied by powerful winds. Numerous homes lack proper insulation or heating utilities appropriate for such harsh weather. Consequently many

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<sup>28</sup> Tom Crash, “HUD Accepts New Census Numbers – Population Soars from 15,000 to 28,000,” *Lakota Country Times*, July 27, 2005.

<sup>29</sup> Oglala Sioux (Lakota) Tribe, Tribal Ordinance, *Charter of Oglala Sioux (Lakota) Housing* [South Dakota, 2007], 2. <http://www.oslh.org/Charter.pdf> (accessed October 20, 2009).

<sup>30</sup> Nick Coleman, “U.N. Visits America’s Third World,” *Star Tribune*, October 31, 2009. <http://www.startribune.com/opinion/commentary/67761687.html>

<sup>31</sup> Shannon Shaw, “High Levels of Black Mold Found in Pine Ridge Reservation Homes,” Associated Press, <http://www.mold-help.org/content/view/263/> (accessed December 26, 2009).

residents are plagued with excessive heating expenses that demand a large portion of their meager incomes, while some are forced to go with little to no heating. Such circumstances leave residents vulnerable to hypothermia, periodically resulting in deaths on the reservation.<sup>32</sup> Due to vast housing shortages, many Pine Ridge residents resort to sharing accommodations with family members, making it not unusual for a three-bedroom home to be occupied by up to 30 people.<sup>33</sup> It is estimated that a third of Native homes are overcrowded.<sup>34</sup> Due to the extreme poverty and lack of housing on Pine Ridge these approximations are likely to be an underestimate of the prevalence of overcrowding on occurring on the reservation. The Cultural importance of family and community often compel the Lakota to take in needy relatives, but such close quarters and high concentration of people can increase the spreading of illnesses, cause stress to the inhabitants and compromise the dwelling's structural integrity.<sup>35</sup>

These pitiful living conditions have been likened to those frequently found in developing countries.<sup>36</sup> Alas, most American's are oblivious to their nations own third world, tucked away in the shadows of their beloved Mount Rushmore.

Although, the average American may be apathetic or unconcerned to the destitution on Pine Ridge and other Native American reservations, the United Nations is not. The Special Rapporteur on the Right to Adequate Housing has been commissioned to conduct an investigation in November of 2009.<sup>37</sup> The rapporteur's report will evaluate whether the housing situation at Pine Ridge is in accordance with the United States' human rights obligations and will be submitted to the UN Commission on Human

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<sup>32</sup> "History: Celebrating 15 Years of Service," Red Feather Development Group, <http://www.redfeather.org/about/history> (accessed November 18, 2009).

<sup>33</sup> "A Quiet Crisis: Federal Funding and Unmet Needs in Indian Country," U.S. Commission on Civil Rights, July 2003, p.61, <http://www.usccr.gov/pubs/na0703/na0204.pdf>, (accessed December 22, 2009). p. 50, 111.

<sup>34</sup> Ibid. 61.

<sup>35</sup> "A Quiet Crisis: Federal Funding and Unmet Needs in Indian Country," U.S. Commission on Civil Rights, July 2003, p.61, <http://www.usccr.gov/pubs/na0703/na0204.pdf>, (accessed December 22, 2009). p. 62.

<sup>35</sup> Ibid, 62.

<sup>36</sup> Roberta Youmans, Federal Housing Finance Board, "*Native American Housing Needs and Proposed Recommendations.*" Background paper presented to the Millennial Housing Commission, 2002, 2.

<sup>37</sup> A *special rapporteur* is a U.N. official appointed to report the proceedings of the investigation.

Rights in 2010.<sup>38</sup> Article 25 of the Universal Declaration of Human Rights recognizes the right to adequate housing; the U.S. government could then be held accountable for their negligence on Pine Ridge due to the inadequate provisions of housing on the reservation.<sup>39</sup> The poverty on Pine Ridge and many other struggling reservations has long been attributed to broken promises and treaties with the United States government. The relationship between the reservations and the federal government is unique, treaties devised in the 19<sup>th</sup> century maintain that in exchange for their homelands, the government will provide protection and services, establishing has a trust responsibility to the Native communities. In 1877, congress promised the Sioux “comfortable” homes and other services if they obliged and relocated to the reservations.<sup>40</sup> Today these promises indicate the government has a duty to provide certain services, including health care, education, natural resources and housing, to the Indians residing on the reservations.<sup>41</sup> This federal obligation to provide housing was ignored for the most part as the reservations were not included in most the housing legislation until the 1960’s. Unfortunately ignoring the problem for a hundred years has created such severe conditions that the government has struggled to address in the past fifty years.

The Bureau of Indian Affairs, an agency within the United States Department of the Interior, has built a large number of the houses on Pine Ridge during the 1970’s.<sup>42</sup> Predictably, these cheaply built homes are in decrepit shape today. In addition to these “shoddy” government homes, used mobile homes are a common housing arrangement on the reservation. These trailers are commonly bought or donated secondhand and are in worn condition when obtained by tribe members. Between the aged government homes, trailers and other housing variants, 60% percent of homes on the Pine Ridge Reservation are

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<sup>38</sup> International Indian Treaty Council, “U.N. Official Investigating Housing Conditions at Pine Ridge,” *Native Times*, October 13 2009. [http://nativetimes.com/index.php?option=com\\_content&view=article&id=2495:un-official-investigating-housing-conditions-at-pine-ridge&catid=53&Itemid=29](http://nativetimes.com/index.php?option=com_content&view=article&id=2495:un-official-investigating-housing-conditions-at-pine-ridge&catid=53&Itemid=29), (accessed October 16, 2009).

<sup>39</sup> *Ibid.*

<sup>40</sup> U.S. Senate Committee on Indian Affairs, *Indian Affairs. Laws and Treaties*, vol. I, ed. Charles J. Kappler, (Washington: Government Printing Office, 1904), 169.

<sup>41</sup> Wendy L. Helgemo, “Native American, Native Hawaiian and Alaska Native Housing Programs,” National Low Income Housing Coalition, May 6, 2000, [http://www.nlihc.org/detail/article.cfm?article\\_id=6062&id=19](http://www.nlihc.org/detail/article.cfm?article_id=6062&id=19), (accessed December 27, 2009),

<sup>42</sup> Thunder Horse, “Out of Sight, Out of Mind,” *Republic of Lakota*, November 15, 2009, <http://www.republicoflakotah.com/2009/out-of-sight-out-of-mind/> (accessed December 14, 2009).

considered to be substandard.<sup>43</sup> The above statistics are only a sample of the profound inadequacies plaguing the lives of the Lakota people. Needless to say, the Pine Ridge Reservation is in urgent need of assistance and adequate housing.

Thankfully, a number of housing organizations have responded to such destitution by attempting to develop creative and sustainable housing solutions for the Lakota people and other impoverished Native communities. What has become one of the more exciting and promising approaches to this crisis is the introduction of straw-bale construction on the reservations. The straw-bale strategy has many advantages, and appears to be a feasible housing alternative to the dire circumstances facing the tribal nations. A straw-bale structure utilizes bales of straw as the exterior wall materials. Bales are then stacked atop a concrete foundation in wood framing and coated in a heavy plaster to provide an exterior shell to the walls. The structure's roof and interior walls are then commonly constructed out of conventional building materials.



**Figure 2:** A straw bale home under construction demonstrates the building method of bale stacking for wall construction.

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<sup>43</sup> Nick Coleman, "U.N. Visits America's Third World," *Star Tribune*, October 31, 2009. <http://www.startribune.com/opinion/commentary/67761687.html>

As a developed nation with advanced building technologies, some builders and homeowners are skeptical of straw-bale and other building systems that rely primarily on earth materials. What has been forgotten is that for all of human existence man has used straw, grass, mud and other natural earth materials to build safe and dependable shelter. Currently, nearly three billion people, on six different continents, reside in dwellings constructed of earth.<sup>44</sup> These indigenous traditions, using local materials and requiring only human labor and basic tools, have been passed down through the centuries and refined with simple engineering. Straw-bale is simply a hybrid of traditional systems that with the help of modern technology and engineering has been adapted into a system that can be integrated into our modern housing paradigm. The use of straw in bale form, in particular originated in the late 1800's when the scarcity of wood in the newly settled Sand Hills of Nebraska forced pioneers to devise a new system of building.<sup>45</sup> A few of these original straw-bale structures are documented to still be standing today, offering a testament to the original ingenuity and durability of this type of building.<sup>46</sup> The innovative technology has continued to be dabbled in over the past century and has experienced a renaissance in the past few decades, offering significant improvements in the construction process and efficiency of the building method. Various alternative building advocates have recognized the potential for straw-bale to be used as a sustainable building system for mainstream housing. Only recently has the potential of this building approach been realized as sustainable solution for the poorly housed in rural America, offering especial potential in the impoverished native communities.

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<sup>44</sup> Ronald Rael, *Earth Architecture*, (New York: Princeton Architectural Press, 2008), 9.

<sup>45</sup> Clarke Snell, *Building Green: A Complete How-To Guide to Alternative Building Methods*, (New York: Lark Books, 2005), 341.

<sup>46</sup> Ibid.



**Figure 3 & 4:** Historic Photos of early straw-bale homes in Nebraska <sup>47</sup>

Working on various Indian reservations on the Great Plains, the Red Feather Development Group has been one of the most proactive organizations to confront the housing needs of impoverished Indians by providing sustainable and affordable homes. Red Feather partners with Indian communities to help tribal members build their own homes and provide local solutions to the housing needs. Originally offering conventionally stick-built homes, Red Feather recognized the growing potential of straw-bale to provide a better housing option. In 1999 the non-profit teamed with architecture students from the University of Washington and Penn State University to launch the American Indian Sustainable Housing Initiative. The goal of this partnership has been to combine “community development education with sustainable hands-on, volunteer-friendly straw bale home construction as a feasible means for reservation communities to use their own resources to improve the housing issue facing many of their reservations.”<sup>48</sup> Today, Red Feather continues to work with college architecture interns and has an in house architect to help prepare the technical and design aspects of their homes. The switch to straw-bale construction has created a specialized standard of home construction and the contribution of architects has been extremely important. Red Feather depends on a team architects and contractors to lead volunteers work parties in building straw-bale homes on the reservations with hopes to eventually transfer the knowledge and skills

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<sup>47</sup> Photos from <http://www.oekofilm.de/content/images/34ab070a458df6b05437437426f657dc.jpg> & <http://www.prairiefirenewspaper.com/2009/11/natural-building-pioneers-in-nebraska-had-it-right>

<sup>48</sup> “History: Celebrating 15 Years of Service,” Red Feather Development Group, <http://www.redfeather.org/about/history> (accessed October 20, 2009).



completely over to the reservation for genuine independence and a sustaining housing solution. Today, the sustainability of this system has become very apparent, with environmental, economic and social aspects that prove to make this housing formula compatible with the specific needs of struggling reservations. Red Feather has since built 35 straw-bale homes on different reservations on the Great Plains with much success and has developed a detailed step-by-step construction manual for would be straw bale builders.

Straw may not provide as much excitement as other new “green” building technologies but the material is inherently sustainable and it’s simplicity contributes to the overall environmental quality of this approach. In the Northern Plains, straw is plentiful and fairly accessible to native communities, as many reservations lease fields to wheat farmers.<sup>49</sup> Commonly considered the waste product of harvested grain, straw does not attract much use or demand. Often, when unwanted, straw is commonly disposed of through annual burnings, which can release up to 60,000 tons of carbon monoxide and create lung-irritating smoke hazards.<sup>50</sup> Employing straw as a building material creates a constructive use of a waste product and can reduce pollution. Additionally, this natural material can be grown in less than a year and is fairly inexpensive.<sup>51</sup> Moreover, straw presents superior insulating capabilities and can significantly increase the energy efficiency of a home. Depending on the type of straw and the thickness of the walls, the bales offer significantly higher R-values than conventional construction materials.<sup>52</sup> This improvement in insulation allows homes to retain heat more efficiently and reduces excessive heating costs. Additionally, utilizing straw, rather than manufactured conventional materials such as plaster board, fiberglass insulation and exterior siding, reduces the construction costs and the carbon footprint of the home. Luckily, the environmental appeals of straw-bale are not the only enticing aspects of this home construction system.

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<sup>49</sup> Sergio Palleroni and Christina Eichbaum Merkelbach, *Studio at Large: Sustainable Design Solutions from the Pacific Northwest* [Seattle: University of Washington Press, 2004], 99.

<sup>50</sup> Athena Swentzell-Steen, Bill Steen and David Bainbridge. *The Straw Bale House*. [White River Junction, VT: Chelsea Green Publishing Company, 1994], 27.

<sup>51</sup> *Ibid.*

<sup>52</sup> *R-value* is a materials rating measuring a material’s resistance to heat flow. The higher the R-value the better the insulation is at preventing heat from escaping.

Building with straw-bales offers many economic benefits that contribute to the system’s overall feasibility. By replacing a portion of the building materials with straw, certain savings in material costs can be made. The system also relies less on outside, skilled labor, reducing the labor costs of the construction. Furthermore, the improved energy efficiency of straw-bale can significantly reduce the utility costs of the home and making the home less expensive to maintain. Robert Young, the founder of Red Feather insists, “In the end, the building is as sound as any other and is up to four or five times as energy efficient as a stick-frame house.” With those utility savings, families would be more financially able to pay the mortgages on their new homes.<sup>53</sup> Between the saved material and labor costs, Young has contended that Red Feather’s straw-bale homes cost 40% less than the cost of to the conventional stick frame homes the organization used to build.<sup>54</sup> Furthermore Red Feather’s project manager Mark Jensen has found that the straw-bale homes his organization constructs can be comparable in price to the proposed HUD homes, but often greatly exceed in quality and performance.<sup>55</sup> Partnering with corporate sponsors and relying on volunteer labor Red Feather experienced significant success in the summer of 2009 in constructing a high quality sustainable home within a reasonable price range for an Indian family on the Hopi reservation. Jensen provided the following details about the straw-bale home:

Home Size	2732 square feet: 3 bedrooms + 1.5 bath
Features	Radiant Floor Heating, Top of the line windows, Solar Water Heating system, Whirlpool Appliances
Total Cost	\$83,000
Price Paid by Owner	\$62,000
Price of a Comparable HUD Home	\$156,000

<sup>53</sup> Codi Newton, “One Bale at a Time,” *MontanaLiving.com*, October 11, 2008, <http://www.montanaliving.com/ME2/Audiences/dirmod.asp?sid=&nm=&type=Publishing&mod=Publications%3A%3AArticle&mid=8F3A7027421841978F18BE895F87F791&tier=4&id=CB342641068C4AC9A88F0A75A6EA061E&AudID=5FD5ADA1ED3642749115B1A442CC46D1>

<sup>54</sup> Robert Young, “Homes on the Range: How to Save the Lives of Native Americans with Bales of Straw and a Little Elbow Grease,” *Best Life* 5, no. 3(April 2008): 66.

<sup>55</sup> Mark Jensen, phone interview by author, January 7, 2010.



**Figure 5:** A completed straw bale home built by Red Feather similar to the home described above.

Jensen attributed much of the success of this project to the saved labor costs due to volunteer labor and donated materials from sponsors. Red Feather's goal is to establish partnerships between such sponsors with reservations so eventually the whole operation can be handed over to the tribe to run independently, providing economic sustainability as well.<sup>56</sup>

Socially, straw-bale construction encourages self-sufficiency and community development. One of the unique aspects of the straw-bale approach is the ability to engage the community.

“When you're building with stick frame, there's a lot of power tools you need, there's complicated joinery and nailing patterns and all this stuff that can be intimidating in the community we work with,” said Jensen, “With straw bale, if you can play with legos or stack blocks, you can build the main structure of your home. It's a very simple and un-intimidating way of building.”<sup>57</sup> This volunteer-friendly aspect is important because straw-bale is labor intensive, requiring many sets of hands, although there are no age or skill prerequisites. The straw-bale approach offers a community quality that is reminiscent of the barn-

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<sup>56</sup> Mark Jensen, phone interview by author, January 7, 2010.

<sup>57</sup> Katy Tomasulu, “Community Building: Red Feather Relies on Volunteer-Friendly Straw-Bale Construction to Provide Affordable Efficient Homes to Native American Families in Need,” *Eco Home Magazine*, August 18, 2009, <http://www.ecohomemagazine.com/alternative-materials/community-building.aspx> (accessed October 22, 2009).

raising tradition, engaging the neighbors and family to lend a hand while providing an opportunity for social interaction among members.

Additionally, community participation creates pride in the constructed home and can lead to improved maintenance of the home. Architect and Lakota member, Tamara Eagle Bull, explains that government housing on the reservation does not inspire much pride or respect in the residents due to cultural inappropriateness, lack of ownership, and lack of involvement in the construction and design process.<sup>58</sup> Young recognizes this tendency and contends, “If they (the homes) are not yours, you will not care for them.”<sup>59</sup> Straw-bale homes require labor by the future owners, providing them with a rewarding experience and creating an extra incentive to care for their home. The sustainable factors and use of earth products further offers cultural appeal to the native communities that traditionally value environmentalism opportunities to live in balance with Mother Nature. Furthermore, straw-bale offers transferable potential, allowing the reservation to develop a straw-bale construction business and become independent of external housing aid, an opportunity for self-sufficiency, which would create an overwhelming amount of pride on a struggling reservation.

With this building approach certain limitations have emerged. One of the first issues is mistrust of the system and lack of familiarity within the general construction industry. When Red Feather first became involved with straw-bale construction in 2000 they approached the Pine Ridge community and built their first straw-bale home as a demonstration and received hesitant responses. According to Jensen, community leaders were cautious due to capacity and infrastructure limitations of the reservation.<sup>60</sup> Skepticism also emerged due to unfamiliarity with the housing system. From a construction perspective, water damage vulnerability and moisture prevention is the greatest challenges in constructing and maintaining a straw-bale home. Moisture can cause bales to rot, compromising the structural integrity of the home. For this reason straw-bale feasibility may be limited to dryer climates and would not be

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<sup>58</sup> Tamara Eagle Bull, “Native American Housing on the Pine Ridge Reservation,” [master’s thesis, architecture, University of Minnesota, 1993], 9.

<sup>59</sup> Codi Newton, “One Bale at a Time,” *MontanaLiving.com*, October 11, 2008, <http://www.montanaliving.com/ME2/Audiences/dirmod.asp?sid=&nm=&type=Publishing&mod=Publications%3A%3AArticle&mid=8F3A7027421841978F18BE895F87F791&tier=4&id=CB342641068C4AC9A88F0A75A6EA061E&AudID=5FD5ADA1ED3642749115B1A442CC46D1>

<sup>60</sup> Mark Jensen, phone interview by author, November 2, 2009.

appropriate in moist and humid climates. Unfortunately this moisture risk commonly discourages some from pursuing straw-bale construction, even when in dryer climates.<sup>61</sup> These limitations continue to be resolved, as the straw-bale building practice grows in popularity and with more experimentation. Greater engineering and design improvements have helped reduce moisture risks in the construction. For example, alternative building experts, Clark Snell and Tim Callahan advise carefully planning a “holistic water strategy,” which includes extra design features to keep bales off the ground by placing them on stem walls or sill plates and away from condensation. Also they recommend taking extra pre-cautions to block moisture by designing extra long roof overhangs, covering walls with a “consciously designed plaster,” and sealing all vulnerable joints with trim.<sup>62</sup> In addition to Snell and Callahan’s recommendations are multiple other moisture prevention strategies that have been developed by experienced straw-bale builders and are provided in a variety of books offering technical advice in straw-bale construction. The availability of resources and growing interest offers promise for further development and acceptance of the building practice.

More recently the Pine Ridge community has experience a renewed interest in straw-bale construction. Old mobile homes are being fitted with an external layer of bales and mud siding to improve the insulating capabilities of the homes and to reduce the heating costs for the family, signaling a growing interest in the benefits of straw-bale. Although Pine Ridge is not currently working with the Red Feather group, a new training initiative has been established. A team of straw-bale and other alternative housing experts has been recruited to develop a new sustainable building curriculum for vocational programs at the local inter-tribal college.<sup>63</sup> The program, called the *Sustainable Affordable and Efficient (SAFE) Homes*, is beginning to transfer the skills and knowledge to reservation members, enabling the Lakota tribes to initiate a new green building industry from within their own community. The

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<sup>61</sup> Athena Swentzell-Steen, Bill Steen and David Bainbridge. *The Straw Bale House*. [White River Junction, VT: Chelsea Green Publishing Company, 1994], 44.

<sup>62</sup> Clarke Snell, *Building Green: A Complete How-To Guide to Alternative Building Methods*, (New York: Lark Books, 2005), 378.

<sup>63</sup> Emily, Sullivan, “The Millennium Development Goals: Environmental Sustainability and Energy Savings with Straw Bale Homes,” *Earthzine.com*, October 7, 2009, <http://www.earthzine.org/2009/10/07/the-millennium-development-goalsenvironmental-sustainability-and-energy-savings-with-straw-bale-homes/> (accessed October 20, 2009).

development of a more independent building effort may alleviate housing shortages and unemployment rates. A member of an intertribal non-profit organization re-iterates this hope, stating, “ All these young people are going to need housing and they are going to need jobs. If we get them jobs building housing, it makes a lot of sense.”<sup>64</sup> This new phase of community development on the reservation will enable tribe members to become more self-sufficient and reliant on their own resources and people for social solutions, suggesting optimism for the future of straw-bale on Pine Ridge reservation. This is ultimate goal of Red Feather: to transfer the technology and knowledge over to the reservations and continue to organize corporate sponsorships with the communities to ensure affordability and quality in the years to come.

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<sup>64</sup> Ben Block, “Can Green Designs Solve a Housing Crises?” *WorldChanging*, July 7, 2008, <http://www.worldchanging.com/archives/008185.html> [accessed October 25, 2009].

The table below summarizes the advantages of straw bale construction and demonstrates the sustainability of the concept.

Environmental Advantages
<ul style="list-style-type: none"><li>• Straw is sustainable</li><li>• Prevents Pollution</li><li>• Excellent insulator</li><li>• Long-Lasting</li></ul>
Economic Advantages
<ul style="list-style-type: none"><li>• Increased energy efficient</li><li>• Reduced labor costs</li><li>• Building Materials Savings</li><li>• Affordable Quality</li><li>• Potential for Self-Sustaining Business</li></ul>
Social Advantages
<ul style="list-style-type: none"><li>• Culturally Appropriate</li><li>• Community involvement</li><li>• Volunteer friendly</li><li>• Transferable</li></ul>

## Case Study: Sustainable Manufactured Housing

The mobile home has long been recognized as the iconic dwelling for America's rural poor. With the associated stigma of being "shoddy" and of poor quality, these manufactured homes have been regarded as inferior. Recent developments, however, have inspired architects and housing advocates to reconsider the potential of this factory-built housing system. This potential, they contend, could transpire to more well thought-out design and overall improvements in quality. The re-vamping of the manufactured home would not only offer greater benefit to those who inhabit the home, but would also introduce a sustainable housing alternative that has hitherto not been an accessible option to the poor.

Manufactured or prefabricated homes refer to structures that are not constructed on site, but rather are built in a factory operation and are transported for on-site installation or assemblage. This system applies the efficiency of assembly-line production to the home construction industry, becoming a popular alternative to stick construction due to the cost benefits associated with such efficiency. First developed nearly 80 years ago, the manufactured housing industry has since developed additional factory-built home design variations, including modular, panelized and precut home systems.<sup>65</sup> These systems all meet the Manufactured Home Construction and Safety Standards, also known as the HUD Code, and are considered legitimate forms of construction for permanent structures.<sup>66</sup> Today many of these systems are indistinguishable from traditionally built homes and present little resemblance to the most commonly recognized manufactured housing system, the mobile home.

The mobile home was one of the first manufactured housing models to be widely produced in America. Made popular in the 1950's and 1960's the mobile home was an inexpensive housing alternative for World War II veterans returning home to a shortage of affordable housing.<sup>67</sup> The structures were constructed on a chassis, and could be uprooted and transported. These homes, which included some the

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<sup>65</sup> Descriptions of each system included in Appendix.

<sup>66</sup> Lance George and Milana Barr, *Moving Home: Manufactured Housing in Rural America*, Housing Assistance Council, December 2005, 2.

<sup>67</sup> Manufactured Housing Institute, "The History of the Manufactured Home" Manufactured Housing Institute, [http://www.manufacturedhousing.org/lib/showtemp\\_detail.asp?id=448&cat=whats\\_hot](http://www.manufacturedhousing.org/lib/showtemp_detail.asp?id=448&cat=whats_hot) (accessed November 2, 2009).



regular amenities of a conventionally built home, could be bought at a discount, partially due to factory production and the use of lower quality materials and construction. Until 1976, mobile homes were not required to meet certain building codes and obtained the reputation of being “shoddy.”<sup>68</sup> In 1975 a report created by the Center for Automotive Safety characterized mobile homes as having “poor design, cheap materials, and sloppy workmanship,” which equated to poor long-term stability and a susceptibility to deterioration and storm damage.<sup>69</sup> Nonetheless, the affordability of mobile homes made them a popular option for those in need of inexpensive housing.

Today, nearly 7.5% percent of American housing units are manufactured mobile trailers.<sup>70</sup> Newer models are less mobile and have higher-standards of quality, shedding their shoddy reputation. The cost and convenience of mobile homes have continued to make this type of housing a more economic choice for low-income families, with mobile home resident’s incomes estimated to be 35.7% lower than the median income for non-mobile home households.<sup>71</sup>

Mobile homes are especially appealing in rural communities, where there are few affordable housing options and fairly inexpensive land prices. “Mobile homes will make up a significant part of the housing market in any place you can find significant rural poverty,” contends Duke public policy professor Jacob Vigdor.<sup>72</sup> This type of housing arrangement is also most prevalent in the South where nearly 56% of all mobile homes are located.<sup>73</sup> Structural qualities of mobile homes make them more appropriate for the warmer climates, whereas mobile homes can lack adequate insulation appropriate for harsh winter climates. Unfortunately substandard conditions of manufactured homes persist in spite of the regulations and quality improvements made in the past forty years. The rural south, in particular, suffers

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<sup>68</sup> Lance George and Milana Barr, *Moving Home: Manufactured Housing in Rural America*, Housing Assistance Council, December 2005, 19-21.

<sup>69</sup> *Ibid.*

<sup>70</sup> U.S. Census Bureau, *Percent of Housing Units That Are Mobil Homes*, American Community Survey, 2008, [http://factfinder.census.gov/servlet/GRTTable?\\_lang=en&-format=US-30](http://factfinder.census.gov/servlet/GRTTable?_lang=en&-format=US-30)(accessed November 12, 2009).

<sup>71</sup> Lance George and Milana Barr, *Moving Home: Manufactured Housing in Rural America*, Housing Assistance Council, December 2005, 14.

<sup>72</sup> Hibah Yousuf, “Most Mobile Homes are in the South – Census,” CnnMoney.com, September 23, 2009, [http://money.cnn.com/2009/09/22/real\\_estate/mobile\\_homes/index.htm](http://money.cnn.com/2009/09/22/real_estate/mobile_homes/index.htm), (accessed November 10, 2009).

<sup>73</sup> Hibah Yousuf, “Most Mobile Homes are in the South – Census,” CnnMoney.com, September 23, 2009, [http://money.cnn.com/2009/09/22/real\\_estate/mobile\\_homes/index.htm](http://money.cnn.com/2009/09/22/real_estate/mobile_homes/index.htm), (accessed November 10, 2009).

from inadequate conditions, with more than double the number of substandard mobile homes than any other region in the U.S in part due to higher rates of poverty in this region.<sup>74</sup>

What has recently intrigued a number of architects and contractors to reconsider the manufactured housing systems is the efficiency of the production and associated cost reductions when compared to conventional construction. Now becoming attractive to the middle class housing market, recent quality improvements and system variations are proving that manufactured systems hold potential for greater sustainability, quality and dignity in housing for needy families. With the popularity of modular and panelized construction systems, the manufactured housing industry is hailing their factory approach as “the future of home building.”<sup>75</sup> The future of ultra-affordable and sustainable building may also be found in the manufactured housing approach. A handful of architects, housing advocates and students recognize the potential for a new generation of manufactured mobile homes as a solution to the overwhelming housing conditions of the rural south.

Architecture schools have led some of the preliminary investigations of manufactured housing, attempting to demonstrate the sustainable and economic potential through design/build course projects.<sup>76</sup> A semester-long workshop at the University of Arkansas School of Architecture designed and built a manufactured home for a low-income family for under \$60,000. Students recognized the cost benefits of manufactured construction and felt that the efficiency and convenience of this approach would help them remain within their tight budget and four month time frame. The constructed home maintained some of the conventional design elements of a conventional manufactured home, remaining in a rectangular shape with a concrete brick foundation, but included more careful design elements to improve the home’s look and efficiency. Students, faculty and the community deemed the project a success and maintained, “If we had not used the modular process we would not have been able to produce a house of even this limited

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<sup>74</sup> Lance George and Milana Barr, *Moving Home: Manufactured Housing in Rural America*, Housing Assistance Council, December 2005, 21.

<sup>75</sup> “Modular Difference,” Modular Architecture. <http://www.modulararchitecture.com/modular-difference/> (accessed November 20<sup>th</sup>, 2009)

<sup>76</sup> A *design/build* project is a course where students take-part in the design phase of the structure and then provide the labor, offering hands on experience in both designing and constructing homes.

scope in such a short time. We were satisfied, and even fascinated, with this process throughout our involvement ...”<sup>77</sup>

Also at the research level, University of Mississippi Architecture professor Michael Berk, has created a next-generation “green” mobile home prototype, appropriately named the GreenMobile, shown below. Berk, a manufacturing specialist and architect, realized the inadequate conditions of aged mobile homes and the need for more long-lasting and sustainable manufactured housing options for the Mississippi Delta region. Berk recognized the shortcomings of mobile homes and believes they could be greatly improved by incorporating more quality materials and designed in a more energy efficient manner. With architectural expertise and training, the “shoddy” mobile home of the rural South could be transformed into a more appropriate and dignified affordable housing option



**Figure 6 & 7: Models of the GreenMobile Prototype**<sup>78</sup>

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<sup>77</sup> Gregory Herman, “Market Modular,” in *Expanding Architecture: Design as Activism*, ed. Bryan Bell and Katie Wakeford (New York: Metropolis Books, 2008), 194-199.

The proposed construction of the GreenMobile would rely on local, sustainable materials and local labor. Structural insulated panels (SIPs) would be utilized for exterior walls, providing appropriate insulation and a tight exterior envelope to increase the home's energy efficiency.<sup>79</sup> Berk also proposes the use of locally grown and harvested wood that has obtained sustainable-certification. By utilizing local wood from Mississippi, the production of the GreenMobile would include less transportation demands and support of local industry. Additionally, homes would include Energy Star appliances and other energy efficient utilities.

The GreenMobile also encompasses many conscious design features to make the structure more energy efficient and less reliant on air conditioning. The home includes passive design features with strategically placed windows to allow for natural lighting and cross ventilation. These design details allow for better use of the sun and wind, increasing the home's efficiency and making it more hospitable in the hot and humid southern climate. Prefabricated homes are frequently positioned without consideration to the site's solar or wind orientation, making the dwelling "aggressively site-less."<sup>80</sup> Berk addresses this disconnect by including instructions for proper site orientation and proposes a collection of tree plantings to be included with the home's kit to make better use of solar strategies. Berk, also designed the home to allow for photovoltaic panel additions to be appropriately oriented on the structure, an opportunity for homeowners to further reduce their energy use. An agreement with the Tennessee Valley Authority to supply solar panels to the GreenMobile kits has also been proposed and is in the works.<sup>81</sup>

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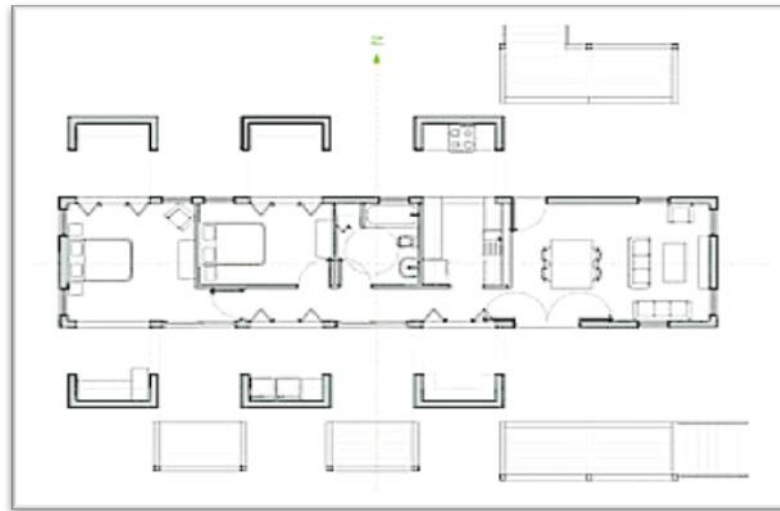
<sup>78</sup> Preston Koerner, "GreenMobile, Ultra-Affordable, Modular Green Homes," January 18, 2008, <http://www.jetsongreen.com/2008/01/greenmobile-ult.html>

<sup>79</sup> A SIP is panel system that includes a rigid foam insulation panel between two pieces of plywood and considered a new sustainable building technology.

<sup>80</sup> John Quale, "EcoMod: Exploring Social and Environmental Justice through Prefabrication," In *Expanding Architecture: Design as Activism*, ed. Bryan Bell and Katie Wakeford [New York: Metropolis Books, 2006],201.

<sup>81</sup> Heather Livingston, "Mississippi State Brings Sustainability Down Home: Architecture Professor Champions Green Mobile Homes," *AIArchitect News* 15. (February 29<sup>th</sup>, 2008). [http://info.aia.org/aiarchitect/thisweek08/0229/0229p\\_mobile.cfm](http://info.aia.org/aiarchitect/thisweek08/0229/0229p_mobile.cfm) [accessed September 20, 2009]

Berk's innovative hybrid mobile home demonstrates the sustainable improvements that can be made to the single-wide layout without straying from framework of the industrial model for manufacturing housing (see below figure). He also demonstrates the difference an architect's expertise can make in improving the structure's sustainability and design performance.



**Figure 8:** A layout of the GreenMobile reveals a similar floorplan to a traditional single-wide mobile home.

One of the limitations in this solution is the price. In accordance with the higher quality materials and craftsmanship the GreenMobile is significantly more expensive than more conventional mobile homes. In 2006, Berk hoped the price range would be between \$50,000 and \$60,000 for a two or three bedroom, one bath home.<sup>82</sup> This is nearly twice the price of a traditional low-end mobile home. This is reasonable to some extent due to the numerous economic benefits offered by the ingenuity of the home. First, the energy efficiency and potential for solar offsets would reduce the utility costs of the home significantly. Due to the extended lifespan, the GreenMobile would have the ability to appreciate in value, a quality that conventional mobile homes do not possess.<sup>83</sup> This is an important feature of the home,

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<sup>82</sup> Chase Kasper, "MSU Prof. Goes 'Green' in Next-Generation Mobile Home," Mississippi State University News Bureau. <http://www.msstate.edu/web/media/detail.php?id=4093> (accessed Sept. 17, 2009).

<sup>83</sup> Ibid.

because it offers an opportunity for much needed wealth creation that conventional mobile homes do not enable. Because of this value of appreciation the GreenMobile can be financed through a 30 to 50 year, low-interest loan. The U.S. Department of Agriculture expressed interest in offering such funds, recognizing the benefits the GreenMobile could offer to rural communities. This financing arrangement, Berk insists would make the home “ultra-affordable,” explaining, “Now somebody who could only have afforded a single-wide trailer in the past with a 15-year chattel mortgage actually is going to pay less money to own a really well-built product.”<sup>84</sup>

The potential and ingenuity of Berk’s project has received recognition by various organizations and has won a number of awards. Most notably, the GreenMobile received first-place in the inaugural Lifecycle Building Challenge hosted by the Environmental Protection Agency. A project update in 2008 reported that although hundreds of requests and great interest has been expressed in the project, manufacturerers are still hesitant to pursue the GreenMobile. Berk, frustrated to see his hailed designed still in developmental stages, is waiting for additional industry funds to match a grant received for prototyping.<sup>85</sup> Although the industry is hesitant towards Berk’s innovative idea, a similar mobile home prototype, developed by other architects, has already been produced on a small scale in the South, proving that a new and improved mobile home is possible.<sup>86</sup>

The non-profit organization, Design Corps has experimented with creating an ultra affordable, and sustainable mobile home designs for more than fifteen years. The Design Corps recognized the potential for manufactured housing as a solution for the housing needs of migrant workers in Florida. Housing options for the Mexican workers and their families were limited to old mobile homes (likely produced prior to the establishment of HUD codes) and old farm worker quarters, both of which were

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<sup>84</sup> Jim Villette, “Introducing the GreenMobile of Mississippi State University: GreenMobile Interview 2006,” Mississippi State University College of Architecture, Art and Design website. <http://caad.msstate.edu/mberk/260/GreenMobile--Interview-2006--/> (accessed September 21, 2009).

<sup>85</sup> Preston Koerner, “GreenMobile, the Anticipated Update!” <http://www.jetsongreen.com/2008/01/greenmobile-ult.html>

<sup>86</sup> Laura Shipman, “Migrant Housing,” in *Expanding Architecture: Design as Activism*, ed. Bryan Bell and Katie Wakeford (New York: Metropolis Books, 2008), 186.

often in disrepair and vulnerable to storm damage.<sup>87</sup> In 2004, hundreds of workers and their families were left homeless when their housing was destroyed or heavily damaged by the multiple tropical storms and hurricanes that hit the gulf that year. The Design Corps team, consisting of housing advocates and newly graduated architects, set out to create a manufactured housing prototype for migrant workers that included mobile capabilities, storm protection and ultra-affordability.

The architects incorporated the migrant workers in the design process, in order to fully understand their specific housing needs. This extra effort and consideration allowed the designers “to formulate solutions that addressed the clients’ highest priorities. In this way even the most limited resources were transformed into the most valued product.”<sup>88</sup> What was created was a design that incorporated the needs of the migrant workers and a layout that uses space more efficiently. The resulting mobile structure, including two bedrooms, can withstand winds up to 110 miles per hour, is energy efficient with windows specifically placed for natural ventilation, and will have at least a 30-year lifespan.<sup>89</sup> This hurricane-resistant model became one of many other manufactured designs created specifically for migrant workers over the past fifteen years. Other models are adjusted to accommodate different living arrangements, such as units that are designed to house five or six single male workers.<sup>90</sup> All of these models remain within the manufactured framework and can be produced by conventional producers. Furthermore these homes were able to be manufactured at a reasonable cost, and were acquired by local farm owners and charities to rent to the workers.

On a small scale, the migrant worker housing trailers designed by Design Corps are a success in transforming mobile homes into more quality and sustainable low-income housing. Although GreenMobile has yet to share in this accomplishment, other attempts are being made to inspire more dignified manufactured housing solutions. In 2005, the Innovations in Manufactured Homes (I<sup>2</sup>M HOME) initiative was launched. “The goal of the multi-year, privately funded, multimillion dollar

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<sup>87</sup> Laura Shipman, “Migrant Housing,” in *Expanding Architecture: Design as Activism*, ed. Bryan Bell and Katie Wakeford (New York: Metropolis Books, 2008), 186.

<sup>88</sup> *Ibid.*

<sup>89</sup> *Ibid.*

<sup>90</sup> Bryan Bell, “Architecture as Artifact: Housing For Migrant Farmworkers,” in *Good Deeds, Good Design: Community Service Through Architecture*, ed. Bryan Bell, (New York: Princeton Architectural Press), 175- 182.

initiative is to support organizations across the country that are testing innovative ideas to open the door to homeownership for low and moderate income families and helping them build assets through manufactured homes.”<sup>91</sup> The initiative not only encourages more quality and efficient options for the poor, but is also advocating better financing and public policy. One of the greatest limitations of the GreenMobile project is the cost and true accessibility to those who need ultra-affordable housing. By creating better manufactured housing options and increasing the quality and durability of the homes, I’M HOME hopes to secure better financing options for low-income families to make home-ownership more possible.<sup>92</sup> Although the genuine sustainability of the program is unknown, it remains a very hopeful start in encouraging better manufactured homes options for America’s low-income families. This initiative and others may eventually help make the GreenMobile a reality.

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<sup>91</sup> Camille Palacio, “Manufactured Housing,” National Low Income Housing Coalition, May 2009, [http://www.nlihc.org/detail/article.cfm?article\\_id=6092&id=23](http://www.nlihc.org/detail/article.cfm?article_id=6092&id=23) (accessed November 15, 2009)

<sup>92</sup> *I’M HOME: Innovations in Manufactured Homes* Brochure, 2008, CFED. [http://www.cfed.org/imageManager/I\\_M\\_HOME/imhome2008.pdf](http://www.cfed.org/imageManager/I_M_HOME/imhome2008.pdf) (accessed November 16, 2009).



The table below summarizes the advantages of the GreenMobile design project and demonstrates the sustainability of the concept.

Environmental Advantages
<ul style="list-style-type: none"><li>• Sustainable Construction Materials</li><li>• Energy Efficient Design</li><li>• Extended Life</li><li>• Compatible with Alternative Energy Sources</li></ul>
Economic Advantages
<ul style="list-style-type: none"><li>• Less expensive than stick-built houses</li><li>• Mass producible</li><li>• Ability to Appreciate in Value</li><li>• Reduced Energy Demands</li><li>• Increases Home Ownership</li></ul>
Social Advantages
<ul style="list-style-type: none"><li>• Already established housing arrangement in U.S.</li><li>• Increases Rural Affordable Housing Options</li><li>• Transferable</li></ul>

## Comparison

The two discussed housing strategies present exciting examples of how sustainable architecture is being consciously developed for the lower-income communities and families. Each approach pursues affordable housing in a different manner and in accordance with the differing circumstances and cultures of the two regions. Although both are versatile to some degree, the designs have been produced to respond to specific needs and may not be the most appropriate housing in differing climates or cultures.

The straw-bale approach has certain qualities that make it more suitable for the Pine Ridge community compared to other communities in need of sustainable housing. Eagle-Bull recognizes the complexity of her reservation's challenges, stating, "Solutions to housing problems must be comprehensive and interconnected in order to be lasting and effective."<sup>93</sup> From what has been discussed in the case study, straw-bale appears to be a fairly comprehensive approach, including environmental, economic and social advantages. The significant labor requirement is one of the most difficult aspects of this building system. Most people would not be able to organize fifteen of their friends and family members to dedicate a two to three weeks to home construction, making straw-bale less feasible in the general population. Due to the high unemployment rates on the reservation, the labor demand is much easier to fulfill, making straw-bale more feasible in that community. It also presents a construction system that could be easily integrated into an independent, self-sufficient reservation industry, providing desperately needed jobs to local tribe members. Straw-bale also provides much needed protection from the harsh climate of the Northern Plains. The superior insulating capabilities offers a low-cost insulating alternative that is needed to protect inhabitants from the winter weather of South Dakota and from exorbitant heating bills. The moisture risks, unfortunately make straw-bale construction limited to dryer climates. Finally straw-bale embraces the cultural importance of environmentalism in native philosophy and tradition. Straw-bale presents a hybrid system of previous earth-based building approaches to create

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<sup>93</sup> Tamara Eagle Bull, "Native American Housing on the Pine Ridge Reservation," [master's thesis, architecture, University of Minnesota, 1993], 9.

not only a sustainable product, but also an efficient and high-performing structure. By limiting the need of manufactured materials, the straw-bale homes create a living environment that is more relevant to the culture and traditions of Lakota people, whose poverty often inhibits their ability to pursue traditional customs.

The manufactured housing approaches present a much different solution to a different set of housing needs. The mobile home is an already well-established housing option for the rural poor. Instead of trying to introduce a whole new system of low-cost housing, architects, such as Berk, advocate for re-design of a familiar and trusted system. Although these new green mobile homes still replicate some of the physical characteristics of the conventional mobile home model (moveable, single-wide parameter, factory made etc.) they have been greatly improved and encompass more architectural expertise and detail. The layout of the GreenMobile was intentionally designed to allow for cross ventilation to alleviate the uncomfortable summer heat of the South and includes proper structural components to endure intense storms and weather conditions. Cultural considerations, such as the inclusion of porches on the GreenMobile homes recognize the local vernacular and architectural tradition of the South, which regards the porch as integral component of a home. The convenience of the manufactured system also is more appropriate for the needs of rural impoverished residents. A manufactured home does not require a lengthy construction period and can be inhabited upon arrival to the site. On-site construction may be less feasible in these communities due to the extra expenses and need for alternative housing during the construction period. Depending on volunteer help from friends and family would also be more difficult due to greater employment obligations in Southern communities, compared to those on the reservation. Additionally, the mobility of the manufactured home allows for more flexibility and can be beneficial to a family who may be less inclined to reside in a certain area for long periods of time.

Both systems present a new way of thinking and constructing housing options for low-income families in rural America. These systems also present the potential for alleviating housing problems internationally. Straw-bale construction is based on indigenous building methods. The non-profit organization Builders without Borders believe these indigenous systems have proven the test of time and

continue to be used and improved with modern modifications to create a hybrid system especially suited to the circumstances in developing nations. Additionally the authors of the book *Built by Hand* advocate the use of earth materials, especially straw bales, as an efficient housing technology in different impoverished nations. Straw-bale projects have been erected and successfully accepted by communities on a small scale in countries such as Mexico, Israel, and Russia. Often the circumstances of these impoverished communities call for structures that can be built with local, natural materials, and by unskilled, volunteer labor. Straw-bale home construction is one example of a compatible solution to local conditions.<sup>94</sup>

Manufactured housing systems have also been proposed to serve refugees and natural disaster victims in different emergency housing situations around the world. The GreenMobile itself has been adapted to become a disaster-relief housing model, having the ability to function on or off the electricity grid, and has been sought after by the Federal Emergency Management Agency.<sup>95</sup> In these crisis situations or in circumstances where there is little infrastructure; pre-built manufactured structures can provide large quantities of housing quickly. Although this prototype is still in the developmental stage, it holds promise in providing quick and practical relief in different international crises.

### **Future of Sustainable and Ultra-Affordable Housing**

Through the examples of straw-bale construction and the next generation mobile homes we see the efforts of architects and housing advocates attempting to make sustainable housing and quality design more accessible to a traditionally excluded clientele. There still remain many impoverished communities that need the attention and help of architects and housing advocates to create more feasible and practical homes with affordable financing options. The reason these efforts are limited to only a handful of projects is due to economics. Understandably, architects are hesitant to devote their entire practice to underserved

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<sup>94</sup> Architecture for Humanity, "Medwed Clinic," in *Design Like You Give a Damn: Architectural Responses to Humanitarian Crises*, ed. Kate Stohr and Cameron Sinclair [New York: Metropolis Books, 2006], 246.

<sup>95</sup> Heather, Livingston. "Mississippi State Brings Sustainability Down Home". *AIArchitect This Week* 15, [February 2008], [http://info.aia.org/aiarchitect/thisweek08/0229/0229p\\_mobile.cfm](http://info.aia.org/aiarchitect/thisweek08/0229/0229p_mobile.cfm) [accessed October 20 2009].

populations due to the financial challenges that are associated with such work. Architects should be encouraged to offer a portion of their time to socially based projects, on a pro-bono basis.

Fortunately, there are a few initiatives that strive to unite needy communities with architects willing to provide some volunteer work and delve into the social aspects of their profession. One of the most promising and proactive organizations is Architecture for Humanity (AFH). Realizing the overwhelming need for housing globally, founder Cameron Sinclair recognized that his skills as an architect could help alleviate the difficulty of providing adequate and safe housing. With intentions to provide architectural solutions for humanitarian crises, Sinclair organized a networking system to connect willing architects with aid organizations in need of their design expertise. “Through competitions, workshops, educational forums, partnerships with aid organizations and other activities,” AFH strives to “create opportunities for architects and designers from around the world to respond to crises.”<sup>96</sup> Beginning to be more recognized, with hundreds of projects completed or in the works, AFH now includes branches in individual states that seek both international humanitarian projects, and domestic, local projects. Red Feather’s straw-bale projects, the GreenMobile proposal, and the Design Corps migrant housing, have all been recognized in AFH publications, demonstrating the potential for architecture to help solve the housing needs of the underprivileged.<sup>97</sup> Although many architects have individually pursued pro-bono projects, the network created by AFH does most of the burdensome organizational work, making such volunteer projects more appealing.

Another socially proactive sector of the architecture industry is at the university level. In both case studies, architecture students were involved in the development of the housing projects. Design/Build courses are an effective means of accomplishing these projects. Students provide the creativity, knowledge, planning, labor and enthusiasm and receive credit and experience for their work, while communities and families receive customized, quality homes. One of the greatest advocates of this

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<sup>96</sup> Cameron Sinclair, “ Introduction: I hope it’s a long list...”, in *Design Like You Give a Damn: Architectural Responses to Humanitarian Crises*, ed. Kate Stohr and Cameron Sinclair [New York: Metropolis, 2006], 11.

<sup>97</sup> Architecture for Humanity, *Design Like You Give a Damn: Architectural Responses to Humanitarian Crises*, ed. Kate Stohr and Cameron Sinclair [New York: Metropolis, 2006],

teaching approach was Auburn architecture professor Samuel Mockabee. Mockabee established the rural studio as a response to the housing needs of the impoverished of Hale County, Alabama. Since 1994 upper-class architecture students have had the opportunity to move to Hale County for the semester, become part of the community and use their design skills to develop and build homes and public structures for the community. Students rely on their own ingenuity and creativity to devise housing solutions, often relying solely on donated materials. Mockabee's intentions for this semester-long course are not only to provide his students with experience, but also to make them citizen architects. Mockabee explains, "Now, I am the first to admit that architecture cannot alleviate all the social and physical woes of rural Alabama communities. But what is necessary is a willingness to seek solutions to the community in its own context and not from the outside."<sup>98</sup> Through the community-oriented design process, Mockabee has introduced students to the social obligations of their vocation and the need for moral responsibility in their endeavors. The Rural Studio has proven to be so successful that similar courses have emerged at other architecture schools, inspiring a new generation of architects.<sup>99</sup>

Further recognizing the promise of new avenues in architectural education is the University of Minnesota's Architecture School dean, Thomas Fisher. Acknowledging the potential and need for architecture to be made more accessible to the poor, Fisher suggests a new model of architectural practice, calling it public-interest design. Fisher contends that his profession has indeed remained exclusive, serving "the needs of the wealthiest portion of the human population well and has resulted in an extraordinarily high quality of life for maybe one sixth of humanity."<sup>100</sup> Architecture has already mastered the high-end market. Now, if up to the challenge, architects should attempt new challenges and direct their services toward serving the poor. Fisher believes a new sector of the architecture discipline needs to emerge, similar to the public health sector in the medical field. This development would begin in education and focus on training future "public architects" to serve a new clientele . The new curriculum

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<sup>98</sup> Samuel Mockabee, "The Role of the Citizen Architect," in *Good Deeds, Good Design: Community Service Through Architecture*, ed. Bryan Bell, (New York: Princeton Architectural Press), 152.

<sup>99</sup> Similar courses are offered through various architecture schools, including programs at Yale, the University of Kansas, University of Texas at Austin, Tulane University, Parsons School of Design, University of Utah and University of Arizona.

<sup>100</sup> Thomas Fisher, "Going Public," *Minnesota Architecture* 35, no.6 (November – December 2009): 19.

would include certain traditional courses to learn the basics, but would then expand into specialized courses that focus on appropriate technology, indigenous building, local materials and climate and cultural sensitivity.<sup>101</sup> Instead of being well versed in condominium design, new architects would be able to develop a new paradigm for low-income housing. Fisher acknowledges this is probably a leap the architecture field is not fully willing to commit to yet, but suggests that, with the economic downturn and dwindling job prospects for architects, they should take another look at the vast number of overlooked design jobs, desperately awaiting their attention.

## Conclusion

Architecture and sustainability tend to be services that remain accessible only to a small and privileged number of people, but as the two case studies have demonstrated, there are exceptions, and those exceptions have the potential to make an incredible impact on the lives of those they serve. These projects represent more than just providing adequate shelter. The homes people inhabit can influence the way they live, offering stability, comfort, pride, dignity and security. “We shape our buildings and afterward, our buildings shape us,” admits Winston Churchill<sup>102</sup>. Although the Pine Ridge reservation and rural communities in the south face more than just housing issues, adequate housing often is the first step in addressing other social impediments.

The two housing efforts examined in the case studies present two very different approaches to affordable housing. One offers a very unconventional and indigenous method of building that employs the use of earth materials as a building alternative. The other improves an already established and common housing system, recognizing the efficiency of the approach, but redesigning the system to be more sustainable and more financially beneficial for the inhabitants. These are both very thoughtful, unique design solutions compared to traditionally low-income housing options. What exemplifies these homes and makes them potentially more successful is the careful consideration that goes into the designs, truly

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<sup>101</sup> Thomas Fisher, “Going Public,” *Minnesota Architecture* 35, no.6 (November – December 2009): 53.

<sup>102</sup> Samuel Mockabee, “The Role of the Citizen Architect,” in *Good Deeds, Good Design: Community Service Through Architecture*, ed. Bryan Bell, (New York: Princeton Architectural Press), 152.

considering the needs and limitations of the communities. Although both efforts have yet to be fully accepted or implemented, both reveal what can transpire if more creative effort is concentrated on trying to solve the complicated housing problems of the impoverished communities throughout the country.

Fortunately, more initiatives are striving to do just that. Architecture for Humanity's framework offers professional architects an outlet for their social ambitions, while at the collegiate level design/build courses expose the next generation of architecture students to the roots of those social obligations. With continued success in applying architectural principals and sustainability to lower-income housing efforts, the public-interest-design movement can emerge. Ultimately what we see in the straw-bale homes and new generation mobile homes, is proof that designs that are environmentally sensitive, economic and socially considerate are possible.



## Appendix

**Modular Housing:** This system of manufactured housing includes multiple factory build modules, which are assembled together on site to construct the home.

**Panelized Housing:** This system of manufactured housing includes factory produced wall panels. The panels include the outside sheathing, insulation, plumbing, wiring and inside finishes. Construction includes the assemblage of panels, reducing the labor demands and construction time.

**Pre-cut Housing:** This system of manufactured housing consists of a construction kit that includes all of the construction components for the home pre-cut and prepared for assemblage.

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