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Aboriginal Housing Assessment

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RESEARCH REPORT

Aboriginal Housing Assessment

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Research Report

ABORIGINAL HOUSING ASSESSMENT

COMMUNITY DESIGN NEEDS & PREFERENCES AND APPLICATION OF LOCAL MATERIALS

Prepared for

CMHC SCHL

Canada

Prepared by

CENTRE FOR INDIGENOUS ENVIRONMENTAL RESOURCES

July 2004

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Verbal consent was received from all participants regarding the use of the information, including any photographs, they shared with the research team for the express purposes of this report.

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PREFACE

The Aboriginal Housing Assessment: Community Design Needs & Preferences and the Application of Local Materials study was conducted by the Centre for Indigenous Environmental Resources (CIER) with the assistance of Tall Grass Developments, under contract to the Canada Mortgage and Housing Corporation (CMHC). The contract for the study calls for submission of a draft report on local building materials. This report was prepared to satisfy that requirement. A separate draft report on the alternative design component of the study is under preparation.

CIER is a 100% First Nation directed environmental education, research and consulting organization, based in Brokenhead Manitoba, with our administrative office in Winnipeg, Manitoba. Founded in 1994, CIER was created by a board of First Nation leaders from across Canada. CIER's mandate is to help build the environmental capacity of First Nations. To fulfill this mandate CIER serves and works with First Nation and non-First Nation individuals, communities, and organizations. CIER was responsible for the project management of this study, for the local materials component of the study, and for preparation of the final report.

Canada Mortgage and Housing Corporation (CMHC), the government of Canada's national housing agency, issued the original Request for Proposal and funded the study.

RESEARCH HIGHLIGHT

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ABORIGINAL HOUSING: LOCAL MATERIALS AND DESIGN PREFERENCES

Traditionally, the dwellings of Aboriginal peoples were built with materials on hand and evolved with their way of life. Today, most houses in Aboriginal communities are dwellings designed for an urban, non-Aboriginal culture, built with industrially produced materials often transported from afar.

This change has given rise to two concerns expressed by many Aboriginal communities: that the design of their housing is not appropriate for their culture and that building materials are too often imported, even when local resources could be used to the benefit of the community.

This *Research Highlight* summarizes a study of these concerns. The study looked at use of local materials and housing design of local origin in a selection of Aboriginal communities.

The focus was on homegrown examples and not on demonstration projects that had been initiated or funded externally; these have already been documented. Although suitable communities were selected for studies of materials, no communities were found with suitable examples of local designs. Accordingly, the study focus shifted to needs and preferences related to housing design in communities from each of the major Aboriginal cultural regions in Canada. Also, for the purposes of this study, the idea of culture in relation to housing design was interpreted as domestic activities of daily and seasonal living.

The study documented the experiences of selected Aboriginal communities in the use of local materials for housing and the housing design needs, and preferences expressed by community members and housing administrators.

METHODOLOGY

Information was gathered through site visits and interviews for both the local materials and design components. The method of identifying and selecting the communities for the study was a combination of literature search and word-of-mouth requests for potentially suitable and interested communities, subject to the need for cultural and geographic representation.

Materials

For the materials research, potential communities were identified based on a search of First Nations' websites, business success highlights and suggestions from housing technical advisers and representatives of First Nation governments. Case studies were chosen based on the existence of a significant number of buildings that had used materials from near the community.

Design

For the design component, communities were selected from each of the seven Aboriginal cultural regions of Canada. Economic activity, remoteness and climate were also considered, to ensure that a range of experiences would be reflected. Communities were then contacted to determine their interest in participating.

Site visits and interviews

Communities with homegrown use of local materials were difficult to find. Communities interested in discussing design needs and preferences were easier to find. Interview topics were faxed to the communities before the research visits to allow the interviewees time to consider the topics.

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For the materials component, researchers interviewed the Chief, Band Councillors with responsibilities related to housing, paid and volunteer construction crew, and homeowners and tenants. Four communities were visited to investigate the use of three local materials:

Brick: Sumas First Nation (B.C.)

Log: Nibinamik First Nation (Ont.)

Straw bale: Crow Reservation and Northern Cheyenne Reservation (Montana, U.S.A.)

For the design component, interview participants included the Chief, Band Councillors and administrators with housing responsibilities, community coordinators, housing inspectors, environmental officers, homeowners and tenants, and Elders.

Researchers visited the following 14 communities:

Arctic

Hamlet of Gjoa Haven (Nunavut)

TeltitGwich'in First Nation (N.W.T.)

Eastern Subarctic

York Factory First Nation (Man.)

Kawawachikamach First Nation (Que.)

Western Subarctic

Liidlii Kue First Nation (N.W.T.)

Fort Simpson Metis Nation (N.W.T.)

Northeastern woodlands

Membertou First Nation (N.S.)

Six Nations of Grand River (Ont.)

Plains

Piapot First Nation (Sask.)

Pasqua First Nation (Sask.)

Northwest coast

Tsawout First Nation (B.C.)

Kitsumkalum First Nation (B.C.)

Plateau

Westbank First Nation (B.C.)

Okanagan First Nation (B.C.)

METHODOLOGY LIMITATIONS

The purpose of this research was to obtain baseline information with a focus on community perceptions and preferences. The methods were qualitative and relied on loosely structured interviews. The research did not include technical or economic analysis. The Chief, a Band Councillor or the housing coordinator chose the people to be interviewed.

FINDINGS

Local materials

Findings for each type of local material are organized under four headings: current situation, future considerations, issues and potential.

Brick

Current situation

Sumas First Nation has local clay resources and a brick plant. There are also some trained bricklayers and there is potential for others to learn this skill. While several community buildings are built with brick, few houses have used local material for construction beyond foundations and chimneys.

Future considerations

The Chief and Council of Sumas First Nation are interested in taking advantage of brick to a greater degree and believe that this would have environmental, economic and socio-cultural benefits. Chief and Council believe the benefits would include decreased environmental impacts through minimal transportation of construction materials; more money staying in the community; and increased socio-cultural health and pride when local people are employed and community houses are built with their own hands and resources.

Issues

There are few houses built of brick because of the current structure of government funding that pays for the housing units. Unit subsidies are limited and the use of brick would apparently exceed these limits. In the conventional housing market, brick carries a cost premium compared to other cladding materials

Potential

Although the clay and shale that is the raw material may be found on or near other First Nations' land, brick has minimal application for them given the absence of processing facilities.

Logs

Current situation

Nibinamik First Nation has built log houses with local spruce trees since it was established in its current location in 1970. People in the area were using logs to build homes before that and have developed their own techniques. Expertise in log-building techniques is important to build long-lasting homes that perform well. While full construction skills could take up to four years to acquire, basic skills take about four months.

The community is surrounded by boreal forest and was able to selectively harvest straight trees suitable for log houses for more than 20 years. Unfortunately, a forest fire in the 1990s devastated much of the nearby forest. Suitable trees are now about 15 km (9 ¼ mi.) away, making the use of this local resource less economically feasible. While some people continue to build log homes, the First Nation government has begun building homes with imported, prefabricated materials.

Future considerations

The Chief and Council would like to resume log building when the forest recovers or when the feasibility for travelling to harvest trees improves. Using local resources and labour was seen to have a number of advantages: a sustainable and inexpensive way to provide housing; a way to provide jobs and improve social and economic conditions in the community; a way to reduce the environmental impacts of housing; and a method of house construction that is consistent with a traditional approach that generated pride in the community.

Issues

There has not been an economic analysis of the use of local tree resources compared to prefabricated materials. Government funding usually requires compliance with building code or established practice but building codes do not deal with log construction.

Potential

The number of First Nations with access to suitable forest resources is not known but many communities are situated near such resources. Where nearby resources are not suitable for log construction, they could be traded with forest companies for suitable logs.

Straw bale

Current situation

Northern Cheyenne Reservation and Crow Reservation purchased local straw to build four straw-bale buildings: a private home, the Northern Cheyenne Literacy Center, the Muddy Hall Community Center and the Crow Study Hall. The design and layout of the buildings were developed through an iterative process with community and resident input.

The buildings were constructed with technical support from the American Indian Sustainable Housing Initiative, created by the Red Feather Development Group, a non-profit organization. Straw bales were chosen for economic viability, energy efficiency and relatively simple building techniques that allowed resident, community and volunteer participation during construction.

Future considerations

Local organizations, including Northern Cheyenne Tribal Housing and Northern Cheyenne Tribal Council, are discussing with Red Feather the possibility of forming the first reservation-based sustainable housing program in the United States. The sustainability of the homes due to their low cost and energy efficiency is supplemented with the appeal of having a "natural feel."

Issues

There has not been an economic analysis of the use of local straw resources compared to prefabricated materials. Although straw was locally plentiful, the correct type of baling machine was not as close, which made extra transportation costs necessary. Straw bale construction has known pitfalls (for example, infiltration of water) that require technical expertise in construction detailing.

Potential

Many communities are close to agricultural areas where straw is an abundant waste product from grain crops. Some construction can be completed with a combination of skilled and unskilled labour due to the low-tech requirements of straw-bale walls. Participation in the construction provides socio-cultural benefits, and potential economic benefits, if volunteer labour is used.

Housing design

Needs and preferences

While there were slight differences across cultures and geography, the study found that most of the housing design preferences were the same among the 14 communities visited for this research.

In 12 of the communities, it appeared that the members' design preferences had been addressed to a small extent but two communities—Six Nations and Kawawachikamach First Nation—stood out in terms of design preferences having been integrated into the housing delivery system. In other respects these two communities were quite different from one another.

Six Nations is one of the oldest established reserves in Canada, situated near several large urban areas. It is also the largest, with more than 11,000 residents.

Kawawachikamach First Nation is one of the newest reserves. It is remote and has fewer than 600 residents.

Their approaches to housing program delivery are also different, but both have incorporated a method of evaluating current designs and feeding back the results into future design. Both communities also view occupants as "owners" of their houses over the long term.

All 14 communities emphasized that many of their design needs relate to larger family size and the family orientation of Aboriginal life. The overarching concern was a lack of space. There were examples of three generations living together (grandparents, their children and their children's children); sometimes two families of the same generation were living together in one house; sometimes relatives were visiting for an extended period.

None of the houses had been built to accommodate such large

numbers of people, resulting in cramped living conditions and, occasionally, feelings of inadequacy and distress at the inability to provide for family and friends.

Based on interviews with community members, a typical scenario is that, when a new house is built, it is allocated to a young family (for instance, two adults and two children.) But most family households continue to grow and the house quickly becomes too small. There is no housing market and thus no real possibility to move up.

Household size also increases for reasons other than having more children—relatives come to stay and there are cultural obligations to take them in. There are far fewer housing choices for seniors in most Aboriginal communities and grandparents tend to stay with their families.

Often, houses on a reserve tend to be the same or very similar, being always built for the young families on the waiting list. One design may be used repeatedly due to limited construction skills in the communities and a tendency to stick with the house that you know how to build. Thus, according to community members, it is rare to be offered a choice in the design of the house, other than for cosmetic features such as paint colour and floor finish. In most cases a standard house is offered or a choice is given to select one of two fixed designs.

More space

Most houses in Aboriginal communities are built for four people, yet most family homes have more occupants. Generally, there are not enough bedrooms for each of the occupants to have their own space. Families would like to live in houses that are larger, include more bedrooms and have more than one bathroom. One bathroom for many people, especially children, is simply not enough.

Basements are often seen as a low-cost means of providing additional living space. However, most are not well-insulated or even heated and many basements have mold problems. Some people would like to eliminate basements completely and have only a crawl space. Some people suggested raised or split-level houses as a compromise.

Additional storage and cupboard space as well as space to accommodate one or more freezers is needed in many communities. In particular, those who hunt, fish, gather berries and preserve foods need more food-storage space. Many communities rely heavily on "country food," as imported food is very expensive. Processing country food involves preparation space and considerable storage space as a year's worth of food may be collected in just one season.

Flexible space

The need for flexible interior space was mentioned in many of the interviews. Standard floor plans that divide a house into small rooms and hallways do not allow for comfortable family gatherings and, in many cases, create rooms that are not even large enough to allow the members of the household to eat together.

People would like the option of a more open floor plan that, for example, places the kitchen, living room and eating area within one large room. Such a large room could also be used for feasts, ceremonies, crafts and other traditional activities.

Backup heat source

Communities in Northern Canada and remote communities are concerned with the reliability of their heat source. Many people who have a wood stove are thankful to have this backup heat source. Those who don't often said they would like a wood stove.

Outdoor space and outbuildings

For many communities, food preparation activities occur out of the house. Many people said they would like outdoor space associated with their house for outbuildings, such as sheds and smokehouses. Examples mentioned were space to set up poles for pounding and drying of animal skins, covered tables for cleaning fish and preparing berries, and racks for drying fish.

In addition to sheds and smokehouses, some would like to have a heated workroom attached to the house. Winter is the time for maintenance of equipment such as fishing gear, canoes and outboard motors. Often, repairs are required for snowmobiles or other equipment involved in winter food gathering and preparation.

Closed porches and mud rooms

A closed porch or mud room protects the living space from adverse weather (such as wind gusting into the house) and helps to improve the energy efficiency of the house. It also provides space for people to enter the house, clean up after working outside, remove outdoor clothes and shoes, and store outdoor equipment.

Fire exits

House fires are more common in First Nation communities than elsewhere in Canada and there was a concern with the safety of their homes and potential inability to escape during a fire. The concern relates to lack of proper emergency exits and with use of poor materials, resulting in jammed or iced-up windows and doors.

The needs of children

The general lack of space in the houses resulted in a lack of space for children to play, study and socialize away from the parents. In addition, the small number and size of bedrooms in the homes requires children to share rooms and this was seen as a problem. People would like homes to have more indoor and outdoor places for children.

The needs of the elderly

In Aboriginal communities many people live in the same house all their lives. As they grow older, their houses become less-suited to their needs. Examples mentioned included: steep stairs to enter the house, steep and occasionally winding stairs to the basement and second floor, narrow hallways and doors, small washrooms and storage areas that are out of reach. These create difficulties for elderly people, many of whom need walking aids.

Funds for major adaptation are scarce but those interviewed were divided on whether it was better to adapt homes to the needs of the elderly and add home-care services or to build specialized group housing for community-style living.

Housing options for single people

In many Aboriginal communities people are on waiting lists for housing. When houses become available, they are generally given to families. In some cases, single people do not qualify for the waiting list.

This results in either young people leaving the community or increased crowding problems as they continue living with family. Some communities have started to build multiplex housing units to provide apartment-type living for single people. Many people interviewed emphasized the need to design houses that meet the needs of single people in their communities.

DISCUSSION

Why use local materials?

Community members' opinion was that using local materials for housing construction brought environmental, economic, social and cultural benefits to the community as a whole because:

- Local materials reflect the local environment and thus reinforce cultural identity.
- People identify more strongly with the houses, leading to increased pride and better care and maintenance.
- More money stays in the community. The use of local materials means less money needs to be spent externally and increases local employment through processing of the material.
- Fewer materials need to be transported over long distances and this benefits the environment.

But:

- Supply of materials at the local level is less reliable than at the regional level—catastrophic events can seriously affect a locality but are unlikely to affect a whole region.
- Local materials must be harvested in a sustainable manner for local resources to become a long-term option for housing materials. They need their own management plan.
- Housing construction with local materials, such as logs and straw bales, requires specialized skills. Local labour must be properly trained but skills acquired may not have wider application.
- Local political challenges may impede the use of local materials; community support is key.
- Federal funding requirements (for example, cost limits or compliance criteria) may impede the use of local materials and there may be no flexibility to exempt a requirement even when there is an offsetting circumstance.
- Economic analyses of the feasibility of using local materials and the potential benefits of local materials have not been done; therefore the true benefits of local materials are not yet understood. Such studies should include the true costs (including environmental and social) of the two options. It should also include an analysis of how sensitive are any benefits to proximity, for instance, the distance between the local resource and the community.

Why design for community preferences?

Community members were quite vocal and specific in describing desired improvements to the design of their housing. Interpreting their suggestions to uncover the fundamental reasons that underlie them is not easy, but there appear to be at least three:

1. A desire to maintain the old way of life as much as possible.
2. However, there is recognition that new ways must be accommodated.
3. A diverse collection of practical issues that deal with lifestyles associated with rural or remote areas, often with a severe climate.

The ways that participants suggested to make their interior and exterior living space more suited to their lives would increase pride, satisfaction, safety, and potentially improve social outcomes because:

- Larger homes would result in less crowding, less clutter and fewer accidents in the home whether fire-related or not.
- Flexible designs would mean that homes could be adapted for aging occupants, providing a safer and more satisfying environment.
- Housing designs that provide enough space to allow school children quiet study would lead to better school performance and educational outcomes.
- When the interior space is big enough or flexible enough to host, for example, large gatherings or feasts, community and family obligations are fulfilled, satisfaction is increased and distress reduced.
- When occupants' preferences help determine the design, the house becomes their house and there is pride and a sense of ownership.
- More space in which to pursue preparation of food and maintenance of associated equipment would lead to less physical stress on the physical environment and greater durability of the structure.

But:

- Meeting all the design preferences would mean that a house would have to serve multiple, sometimes contradictory, purposes. Trying to meet all these purposes in the design of houses as typically small as those on a reserve is not possible.
- The backlog of housing needs means that the emphasis is on the current needs of the applicant, not longer-term family growth.
- Limited funding means the emphasis is on the cheapest solution, not necessarily the best. Limited funding does not provide for much flexibility or choice in the type of house. One design, sometimes two, was all that was available.

- Most communities had few homegrown resources for developing customized new house designs or adapting existing designs. Waiting lists make it difficult to include community input in the housing designs.

RECOMMENDATIONS FOR FUTURE RESEARCH

A constant factor underlying the interviews was the lack of analysable data or documentation behind the personal experiences and stories. There are thus many opportunities for gathering and processing information that would improve our understanding of the advantages and disadvantages of incorporating local materials and designs into community housing.

Economic analysis of local materials

An analysis of the true cost of housing construction with local materials (logs and straw) would provide a better understanding of the benefits of using local materials. This full cost analysis should incorporate environmental, social and cultural costs and benefits in a way that reflects an Aboriginal world view and a holistic approach.

Included would be a life-cycle analysis (upstream and downstream environmental impacts of a product, project, or process over its entire life: extracting and processing of raw materials, manufacturing, transportation, use–reuse–maintenance, recycling and final disposal).

Institutional analysis of impediments to innovation

Generally speaking, homegrown examples of use of materials or design development could be found only in a minority of communities. There may be many reasons for this but some hints from the interviews pointed to some possible institutional impediments: a lack of specialized building codes for innovative building materials, such as logs and straw bales, and a funding structure that makes it difficult to try new things or to plan beyond the most immediate pressing need. These concerns were not fully articulated during the interviews and could be better explored with focused research such as:

- Assessment of best practice guides on building with innovative materials with a view to endorsement for their use in housing programs, and
- Inclusion, within the regular cycle of program evaluation, of criteria relative to design used in Aboriginal housing. It could include questions such as: Is the portfolio profile as built under programs a good match to the community profile? Given that the majority of the housing that gets built is program-funded, it should match the community's housing needs.

Develop housing design principles and plans

The research participants' housing design preferences could be used to develop new housing designs or adapt existing ones. There were no major differences in design preferences from one culture to another, suggesting that one set of design principles or a few basic plans could find wide currency. The design principles and plans could then be made available to communities and their housing contractors. The experiences of the two communities where designs had evolved with their housing delivery systems could also be documented in more detail and made available as an example of good practice.

CMHC Project Manager: Phil Deacon
Research Report: *Aboriginal Housing: Local Materials and Alternative Design Needs and Preferences*
Research Consultant: The Centre for Indigenous Environmental Resources (CIER), Winnipeg, Man.

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LE POINT EN RECHERCHE

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LOGEMENT AUTOCHTONE : MATÉRIAUX LOCAUX ET CONCEPTS PRÉFÉRÉS

Les habitations des peuples autochtones, traditionnellement construites avec des matériaux trouvés sur place, ont évolué en même temps que leur mode de vie. De nos jours, la plupart des maisons des communautés autochtones sont conçues en fonction d'une culture urbaine et non autochtone, et elles sont construites avec des matériaux industriels souvent transportés sur de longues distances.

Ce changement a suscité deux préoccupations dans bon nombre de communautés autochtones : la conception de leur logement ne convient pas à leur culture et les matériaux de construction sont trop souvent importés, même lorsque la communauté aurait intérêt à utiliser des ressources locales.

Le présent numéro du *Point en recherche* résume une étude réalisée sur les préoccupations susmentionnées qui a porté sur l'utilisation des matériaux locaux et sur la conception de logements d'origine locale dans une série de communautés autochtones.

L'accent a été mis sur les solutions locales et non sur les projets de démonstration lancés ou financés de l'extérieur et qui sont décrits ailleurs. On a trouvé des communautés adéquates pour l'étude des matériaux, mais aucune n'offrait d'exemples pertinents de conception locale. Par conséquent, le point de focalisation de l'étude s'est déplacé vers les besoins et les préférences reliés à la conception résidentielle dans les communautés appartenant à chacune des grandes régions culturelles autochtones du Canada. Aux fins de la présente étude, on a aussi interprété la notion de culture dans le contexte de la conception résidentielle en termes d'activités domestiques quotidiennes et saisonnières.

L'étude a permis de documenter les expériences de certaines communautés autochtones pour ce qui est de l'utilisation de matériaux locaux pour la construction, ainsi que les préférences et les besoins exprimés par les membres des communautés autochtones et les administrateurs de logements en matière de conception et de types d'habitation.

MÉTHODE

L'information a été recueillie grâce à des visites et à des entrevues portant sur les matériaux ainsi que les éléments de conception. Une recherche documentaire et le bouche à oreille ont permis de trouver et de sélectionner des communautés intéressées à participer à l'étude et ayant le potentiel recherché, sous réserve de critères de représentation culturelle et géographique.

Matériaux

En ce qui concerne les matériaux, la sélection des communautés potentielles s'est fondée sur une recherche sur les sites Internet des Premières nations et les réussites commerciales de même que les suggestions formulées par des conseillers techniques sur l'habitation et les représentants des administrations gouvernementales des Premières nations. Les études de cas ont été choisies dans les secteurs présentant un nombre appréciable de bâtiments construits au moyen de matériaux se trouvant à proximité de la communauté.

Conception

Pour la composante conception, des communautés ont été choisies dans chacune des sept régions culturelles autochtones du pays. On a aussi tenu compte de l'activité économique, de l'éloignement et du climat afin de refléter toute une gamme d'expériences. On a ensuite communiqué avec les communautés pour savoir si elles souhaitaient participer.

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Visites des lieux et entrevues

On a eu de la difficulté à trouver des communautés qui, de coutume, utilisaient des matériaux locaux. Il a été plus facile d'en trouver qui souhaitaient discuter des besoins ainsi que des préférences en matière de conception. Pour permettre aux personnes interviewées de se familiariser avec les sujets d'entrevue, la liste des sujets a été envoyée par télécopieur aux communautés avant la visite des chercheurs.

Pour la composante matériaux, les chercheurs ont interviewé le chef et les membres des conseils de bande responsables du logement, les équipes de construction rémunérées et bénévoles, de même que les propriétaires-occupants et les locataires. Quatre communautés ont été visitées afin d'établir l'utilisation qu'elles faisaient de trois matériaux locaux :

Brique : Première nation de Sumas (C.-B.)

Rondins : Première nation de Nibinamik (Ont.)

Ballots de paille : Crow Reservation et Northern Cheyenne Reservation (Montana, É.-U.)

Pour la composante conception, les participants interviewés comprenaient le chef, les membres des conseils de bande et les autres administrateurs responsables du logement, les coordonnateurs communautaires, les inspecteurs en bâtiment résidentiel, les agents de l'environnement, les propriétaires-occupants, les locataires et les aînés.

Les chercheurs ont visité les 14 communautés suivantes :

Arctique

Hameau de Gjoa Haven (Nunavut)
Première nation des Gwich'in Teltit (T.-N.-O.)

Est subarctique

Première nation de York Factory (Man.)
Première nation de Kawawachikamach (Qué.)

Ouest subarctique

Première nation Liidlii Kue (T.-N.-O.)
Nation Métis de Fort Simpson (T.-N.-O.)

Régions boisées du nord-est

Première nation de Membertou (N.-É.)
Six Nations de Grand River (Ont.)

Plaines

Première nation de Piapot (Sask.)
Première nation de Pasqua (Sask.)

Côte nord-ouest

Première nation de Tsawout (C.-B.)
Première nation Kitsumkalum (C.-B.)

Plateau

Première nation de Westbank (C.-B.)
Première nation d'Okanagan (C.-B.)

LIMITES DE LA MÉTHODE

Cette recherche avait pour but d'obtenir des informations de base axées sur les perceptions et les préférences de la communauté. On a fait appel à des méthodes qualitatives qui s'appuyaient sur des entrevues peu structurées. La recherche ne comprenait pas d'analyse technique ou économique. Les personnes interviewées étaient choisies par le chef, un membre du conseil de bande ou le coordonnateur du logement.

CONSTATATIONS

Matériaux locaux

Les constatations se rapportant à chaque type de matériau local sont regroupées sous quatre rubriques : situation actuelle, considérations futures, enjeux et possibilités.

Brique

Situation actuelle

La Première nation de Sumas a accès à de l'argile à l'échelle locale et elle possède une briqueterie. On y trouve aussi quelques maçons expérimentés et des candidats qui pourraient apprendre le métier. Plusieurs bâtiments communautaires ont été construits avec de la brique, mais peu de maisons contiennent des matériaux locaux, exception faite des fondations et des cheminées.

Considérations futures

Le chef et le conseil de la Première nation de Sumas veulent employer davantage la brique et sont d'avis que cette mesure pourrait comporter des avantages environnementaux, économiques et socio-culturels. Ils pensent diminuer les conséquences environnementales en transportant les matériaux de construction sur une distance minimale; ils souhaitent utiliser la main-d'œuvre et les matériaux locaux afin de conserver l'argent dans la communauté et veulent améliorer le climat socio-culturel et accroître le niveau de fierté en donnant du travail aux résidents et en leur permettant de construire, de leurs propres mains et avec leurs propres ressources, les maisons de la communauté.

Enjeux

En raison de la structure actuelle du financement gouvernemental, peu de maisons sont construites avec de la brique. Les subventions prévues pour chaque logement sont limitées et l'emploi de la brique entraînerait un dépassement de ces limites. Sur le marché du logement courant, la brique entraîne un surcoût comparativement aux autres matériaux de revêtement.

Possibilités

La brique offre peu d'applications en raison de l'absence d'installations de transformation, même si on trouve sur les terres de la Première nation ou a proximité, l'argile et le schiste qui composent la matière première.

Rondins

Situation actuelle

La Première nation de Nibinamik a construit des maisons en rondins avec des épinettes locales depuis qu'elle a emménagé sur l'emplacement actuel, en 1970. Les habitants des lieux employaient du bois rond pour construire des maisons bien avant cette période et ils avaient développé leurs propres techniques. L'expertise est importante dans le domaine de la construction de maisons de rondins pour assurer la durabilité et la performance des ouvrages. Il faut jusqu'à quatre ans pour maîtriser la technique de construction, mais seulement quatre mois environ pour acquérir des aptitudes de base.

Entourée par la forêt boréale, la communauté a réussi, pendant plus de vingt ans, à récolter de façon sélective des arbres bien droits convenant à la construction de maisons de rondins. Malheureusement, un incendie a ravagé la majeure partie de la forêt environnante dans les années 1990. Les arbres convenables se trouvent maintenant à environ 15 km (9,25 milles), ce qui rend cette ressource locale plus coûteuse à utiliser. Certaines personnes continuent de construire des maisons en rondins, mais le gouvernement de la Première nation a commencé à en produire avec des matériaux préfabriqués qu'il importe.

Considérations futures

Le chef et le conseil aimeraient recommencer à construire des maisons en rondins lorsque la forêt se sera régénérée ou lorsqu'il sera plus avantageux de se déplacer pour la récolte des arbres. L'utilisation des ressources et de la main-d'œuvre locales comportait un certain nombre d'avantages : façon durable et peu coûteuse de produire des logements, de créer des emplois et d'améliorer les conditions sociales et économiques dans la communauté; réduction de l'impact des bâtiments sur l'environnement et méthode de construction résidentielle convenant à une approche traditionnelle qui faisait la fierté de la communauté.

Enjeux

Aucune étude de faisabilité économique n'a été réalisée afin de comparer l'utilisation des arbres locaux avec les matériaux préfabriqués. Le financement gouvernemental requiert habituellement la conformité au code du bâtiment ou aux pratiques établies. Toutefois, les codes du bâtiment ne traitent pas de la construction de maisons en rondins.

Possibilités

On ne connaît pas le nombre de Premières nations qui ont accès à des ressources forestières adéquates, mais plusieurs d'entre elles sont situées à proximité de telles resources. Si le bois ne convient pas pour la construction résidentielle, il pourrait être échangé auprès de compagnies forestières contre des rondins convenables.

Ballots de paille

Situation actuelle

La Northern Cheyenne Reservation et la Crow Reservation ont acheté de la paille produite localement pour construire quatre bâtiments en ballots de paille : une maison privée, le Northern Cheyenne Literacy Center, le Muddy Hall Community Center et le Crow Study Hall. La conception et les plans des bâtiments ont été élaborés au moyen d'un processus itératif auquel la communauté et les résidents ont participé.

Les bâtiments ont été construits avec le soutien technique de l'American Indian Sustainable Housing Initiative mise sur pied par le Red Feather Development Group, un organisme sans but lucratif. Les ballots de paille ont été retenus pour leur viabilité économique, leur efficacité énergétique et la simplicité relative des techniques de construction qui permettaient aux résidents, à la communauté et aux bénévoles de participer aux travaux.

Considérations futures

Pour le moment, les organismes locaux, dont la Northern Cheyenne Tribal Housing et le Northern Cheyenne Tribal Council, discutent avec le Red Feather Development Group de la possibilité de créer le premier programme de logement durable dans les réserves des États-Unis. Les maisons obtiennent un caractère durable en raison de leur faible coût et de leur efficacité énergétique, en plus d'avoir une « apparence naturelle » attrayante.

Enjeux

On n'a pas réalisé d'étude de faisabilité économique sur l'utilisation de la paille locale et des matériaux préfabriqués. La paille abondait à l'échelle locale, mais on ne trouvait pas de presse à balles convenable à proximité, ce qui a entraîné des coûts de transport additionnels. La construction en ballots de paille comporte des embûches connues (par exemple, l'infiltration d'eau) qui requièrent de l'expertise technique au niveau des détails d'exécution.

Possibilités

De nombreuses communautés se trouvent à proximité de régions agricoles où la paille constitue un déchet abondant issu de la culture céréalière. Une partie des travaux peut être effectuée par une combinaison de main-d'œuvre qualifiée et non qualifiée, étant donné la faible technologie requise pour la construction des murs en ballots de paille. La participation à la construction possède des avantages socio-culturels et potentiellement économiques si l'on fait appel à des bénévoles.

Conception de logements

Besoins et préférences en matière de conception

Malgré les différences légères relevées en termes de culture et de géographie, l'étude a montré que la plupart des préférences en matière de conception de logements restaient les mêmes dans les 14 communautés visitées.

Dans 12 des communautés, on semblait avoir tenu compte de façon limitée des préférences des membres au niveau de la conception. Toutefois, deux communautés — celle des Six Nations et celle de la Première nation de Kawawachikamach — se démarquaient pour avoir intégré les préférences de conception dans le système de production de logements. Sous d'autres aspects, ces deux communautés étaient plutôt différentes l'une de l'autre.

La réserve des Six Nations est l'une des plus anciennes du pays et se trouve à proximité de plusieurs grandes régions urbaines. Elle est aussi la plus populeuse avec au delà de 11 000 résidents.

La Première nation de Kawawachikamach occupe l'une des réserves les plus récentes. Elle se trouve en région éloignée et compte moins de 600 résidents.

Les approches relativement à l'administration des programmes de logement différaient aussi, mais les deux communautés avaient adopté une méthode pour l'évaluation des concepts courants et l'application des résultats aux concepts futurs. Les deux communautés traitaient les occupants des maisons comme des « propriétaires » à long terme.

Les 14 communautés ont insisté sur le fait que bon nombre de leurs besoins en matière de conception sont reliés à la grande taille des familles et à l'orientation familiale de la vie autochtone. Le manque d'espace constituait la préoccupation dominante. On a relevé des exemples où trois générations cohabitaient (les grands-parents, leurs enfants et leurs petits-enfants); parfois, deux familles d'une même génération vivaient dans la même maison; dans d'autres cas, il s'agissait de parents qui étaient en visite pour une longue période.

Aucune maison n'avait été construite pour accueillir autant de personnes, ce qui causait du surpeuplement et parfois, des sentiments d'impuissance et de détresse face à l'incapacité de satisfaire les besoins de la famille et des amis.

Les entrevues organisées avec les membres de la communauté ont permis d'établir le scénario typique selon lequel les maisons neuves sont allouées aux jeunes familles (par exemple, deux adultes avec deux enfants). Toutefois, la plupart des familles continuent de s'agrandir et les maisons deviennent rapidement trop petites. Et, comme il n'y a pas de marché de l'habitation, il est impossible d'emménager dans une maison plus grande.

Les naissances ne sont pas les seules causes d'augmentation de la taille des ménages — les parents emménagent avec la famille et leur prise en charge constitue une obligation culturelle. Les choix de logement des personnes âgées sont très limités dans la plupart des communautés autochtones, et les grands-parents ont tendance à demeurer avec la famille.

Souvent, les maisons des réserves sont identiques ou très similaires. Elles sont toujours construites pour les jeunes familles inscrites sur les listes d'attente. Le même concept est répété à cause des compétences limitées en construction dans les communautés et de la tendance à conserver les modèles de maison connus. Selon les membres des communautés, on a rarement le choix de concept pour la maison, exception faite de caractéristiques cosmétiques comme la couleur de peinture et le revêtement de sol. Dans la plupart des cas, on offre une maison standard ou on donne le choix entre deux concepts fixes.

Espace accru

La plupart des maisons des communautés autochtones sont construites pour quatre personnes, sauf qu'elles comptent à peu près toutes davantage d'occupants. Généralement, les chambres ne sont pas assez nombreuses pour que chaque occupant ait la sienne. Les gens aimeraient vivre dans des maisons plus grandes, contenant davantage de chambres et possédant plus d'une salle de bains. Une seule salle de bains pour plusieurs personnes, en particulier les enfants ne suffit pas.

Les sous-sols servent souvent à aménager une aire habitable additionnelle à peu de frais. Cependant, la plupart sont mal isolés ou dépourvus de chauffage, et bon nombre d'entre eux présentent des problèmes de moisissure. Certaines personnes aimeraient éliminer les sous-sols complètement pour les remplacer par des vides sanitaires. D'autres ont suggéré de construire des maisons partiellement hors sol ou des maisons à demi-niveaux pour obtenir de l'espace habitable supplémentaire.

Dans bien des communautés, on a besoin d'une aire d'entreposage et d'armoires additionnelles de même que de l'espace nécessaire pour au moins un congélateur. Ceux qui vont à la chasse ou à la pêche, qui vont cueillir des baies ou qui font des conserves d'aliments, ont particulièrement besoin de plus d'espace d'entreposage. De nombreuses communautés dépendent en grande partie des aliments locaux en raison des coûts très élevés des aliments importés. La transformation des aliments locaux requiert beaucoup d'espace pour la préparation et l'entreposage, car il est parfois possible de récolter en une seule saison la provision nécessaire pour un an.

Espace adaptable

Les besoins en espace intérieur adaptable ont été mentionnés dans bien des entrevues. Les plans standards qui divisent une maison en petites pièces et en corridors nuisent aux réunions familiales et, dans bien des cas, créent des aires trop petites pour que les membres du ménage puissent prendre les repas ensemble.

Les occupants aimeraient obtenir un plan d'étage à aire ouverte qui, par exemple, combinerait en une seule grande pièce la cuisine, la salle de séjour et la salle à manger. Cette grande pièce servirait aussi à organiser des fêtes, des cérémonies, des travaux d'artisanat et d'autres activités traditionnelles.

Chauffage d'appoint

Les communautés du Nord et des régions éloignées du pays se préoccupent de la fiabilité de leur installation de chauffage. Nombre d'utilisateurs de poêles à bois s'estiment heureux de disposer de ce chauffage d'appoint. Les personnes qui ne possèdent pas de poêle à bois affirment souvent qu'elles aimeraient en avoir un.

Espace extérieur et dépendances

Dans bien des communautés, la préparation des aliments se fait à l'extérieur de la maison. De nombreuses personnes ont déclaré qu'elles aimeraient disposer de bâtiments extérieurs à leur maison comme des remises et des fumoirs. Comme exemple, on a mentionné qu'il fallait de l'espace pour installer des poteaux pour battre et faire sécher les peaux d'animaux, des tables pour nettoyer le poisson et préparer les baies, de même que des supports pour faire sécher le poisson.

Outre les remises et les fumoirs, certaines personnes aimeraient avoir un atelier chauffé attenant à la maison. L'hiver est le moment propice pour entretenir l'équipement comme le matériel de pêche, les canots et les moteurs hors-bord. Souvent, il faut aussi réparer les motoneiges et l'équipement employé pour amasser et préparer la nourriture pour l'hiver.

Porches fermés et vestibules

Un porche fermé ou un vestibule protège l'aire habitable des intempéries (comme le vent qui s'engouffre dans la maison), et contribue à l'efficacité énergétique de l'habitation. Il offre aussi un endroit pour accéder à la maison, se nettoyer après les travaux extérieurs, retirer ses vêtements extérieurs et ses chaussures, et entreposer l'équipement extérieur.

Sorties de secours

Les incendies résidentiels sont plus courants dans les communautés des Premières nations que dans le reste du pays. Les personnes interviewées étaient préoccupées par la sécurité de leur logement et leur évacuation en cas d'incendie. On a souligné le manque de sorties de secours convenables et l'emploi de matériaux inadéquats qui donnent lieu à des portes et des fenêtres qui ne s'ouvrent pas ou qui sont prises dans la glace.

Les besoins des enfants

Le manque d'espace généralisé dans les maisons empêche les enfants de jouer, d'étudier et d'échanger avec d'autres personnes, sans la présence des parents. De plus, le peu de chambres et leur petite taille obligent les enfants à cohabiter, ce qui est considéré comme un problème. Les répondants souhaitent que les maisons offrent davantage d'espace intérieur et extérieur aux enfants.

Les besoins des personnes âgées

Dans les communautés autochtones, de nombreuses personnes occupent la même maison toute leur vie. Les logements sont de moins en moins adaptés, au fur et à mesure que lers occupants vieillissent. Les exemples mentionnés comprennent ce qui suit : escaliers raides pour accéder à la maison et parfois, un escalier tournant pour se rendre au sous-sol et à l'étage; portes et corridors étroits; petites salles de bains et aires d'entreposage hors de portée. Ces éléments entraînent des difficultés pour les personnes âgées qui sont nombreuses à avoir besoin d'aide pour se déplacer.

Les fonds destinés aux adaptations majeures sont limités. Toutefois, les avis étaient partagés parmi les personnes interrogées : un premier groupe trouvait préférable d'adapter les maisons aux besoins des personnes âgées et d'ajouter des services de soins à domicile; l'autre groupe préférait construire du logement collectif adapté au style de vie de la communauté.

Choix de logements pour personnes seules

De nombreuses communautés autochtones ont des listes de personnes en attente d'un logement. On alloue habituellement les maisons disponibles à des familles. Il arrive, dans certains cas, que les personnes seules ne remplissent pas les conditions pour figurer sur la liste d'attente.

À cause de cette situation, les jeunes quittent leur communauté ou ils continuent de vivre avec leur famille, créant ainsi du surpeuplement. Certaines communautés ont commencé à construire des logements multiplex afin d'offrir des appartements aux personnes seules. Les répondants ont été nombreux à insister sur la nécessité de concevoir des maisons répondant aux besoins des personnes seules de leur communauté.

DISCUSSION

Pourquoi devrait-on utiliser des matériaux locaux?

Les membres de la communauté étaient d'avis que l'utilisation de matériaux locaux pour la construction résidentielle comportait des avantages environnementaux, économiques, sociaux et culturels pour l'ensemble de la communauté, pour les raisons suivantes :

- les matériaux locaux reflètent le milieu et renforcent, par conséquent, l'identité culturelle;
- les gens s'associent encore plus aux maisons, ce qui se traduit par un plus grand sentiment de fierté et un entretien plus soigneux;
- davantage d'argent reste dans la communauté. L'utilisation de matériaux locaux permet de dépenser moins d'argent à l'extérieur et d'accroître l'emploi local grâce à la transformation des matières premières;
- moins de matériaux ont besoin d'être transportés sur de longues distances, ce qui a des retombées positives pour l'environnement.

Aspects négatifs

- L'offre de matériaux est moins fiable à l'échelle locale que régionale — les catastrophes peuvent sérieusement affecter une communauté, mais pas nécessairement une région entière.
- Les matériaux locaux doivent être extraits en respectant le principe de durabilité, pour que les ressources servent d'option à long terme pour la construction des maisons. Il faut un plan de gestion qui leur est propre.
- La construction résidentielle à l'aide de matériaux locaux comme les rondins et les ballots de paille nécessite des connaissances spécialisées. Il faut former convenablement la main-d'œuvre locale, mais les compétences acquises peuvent ne pas être applicables ailleurs.
- Les défis politiques à l'échelle locale peuvent contrer l'utilisation des matériaux locaux. Il importe d'obtenir le soutien de la communauté.
- Les exigences rattachées à l'affectation des fonds fédéraux (par exemple, les limites de coûts ou les critères d'admissibilité) peuvent nuire à l'utilisation de matériaux locaux et il peut être impossible de lever une exigence, même en présence de circonstances particulières.
- Aucune analyse n'a été réalisée sur la faisabilité économique ou les avantages potentiels des matériaux locaux. Par conséquent, on ne connaît pas encore les bienfaits rattachés à ces derniers. Les études devront porter sur les coûts réels (y compris les coûts environnementaux et sociaux) des deux options. Il faudra aussi analyser les avantages de la proximité des matériaux, c'est-à-dire la distance entre la ressource locale et la communauté.

Pourquoi tenir compte des préférences de la communauté dans la conception d'habitations?

Les membres des communautés en avaient long à dire sur les améliorations à apporter à la conception de leurs habitations. Il est difficile d'interpréter leurs suggestions pour découvrir les raisons fondamentales qui les sous-tendent. Voici néanmoins les trois constatations auxquelles nous sommes arrivés :

1. On souhaite maintenir l'ancien mode de vie le plus possible.
2. On reconnaît toutefois qu'il faut s'adapter aux nouvelles façons de faire.
3. Il faut tenir compte d'une série variée d'enjeux pratiques reliés aux modes de vie dans les régions rurales ou éloignées qui sont souvent soumises à un climat difficile.

Les participants ont suggéré d'adapter davantage leur aire habitable et leur espace extérieur à leur mode de vie, afin d'augmenter leur sentiment de fierté, de satisfaction et de sécurité de même que leur intégration sociale, pour les raisons suivantes :

- les maisons plus grandes réduisent le surpeuplement, l'encombrement et les accidents à domicile, qu'ils soient reliés ou non au feu;
- la flexibilité des concepts permet d'adapter les maisons aux occupants âgés en plus de fournir un milieu plus sûr et plus satisfaisant;
- les concepts résidentiels accordant suffisamment d'espace aux enfants pour qu'ils puissent étudier en toute tranquillité se solderont par une amélioration du rendement scolaire et des études plus poussées;
- des espaces intérieurs suffisamment grands ou adaptables pour organiser des réunions nombreuses ou des fêtes importantes permettront de remplir les obligations communautaires et familiales, d'accroître la satisfaction des occupants et de réduire le stress éprouvé par ces derniers;
- les maisons conçues en fonction des préférences des occupants insufflent à ces derniers un sentiment d'appartenance et de fierté;
- une augmentation de l'espace affecté à la préparation de la nourriture et à l'entretien de l'équipement connexe se traduira par une réduction du stress physique subi par le milieu et par une durabilité accrue de la structure.

Aspects négatifs

- Pour répondre à toutes les préférences en matière de conception, il faudra que la maison serve à des fins multiples, voire contradictoires dans certains cas. Il est impossible d'atteindre tous ces objectifs de conception dans les petites maisons que l'on construit habituellement dans les réserves.
- Les besoins de logement accumulés nous obligent à mettre l'accent sur les problèmes courants des demandeurs et non sur la croissance à long terme de la famille.
- Les ressources financières limitées donnent préséance aux solutions les plus économiques, qui ne sont pas nécessairement les meilleures. Elles laissent peu de flexibilité ou de choix au niveau du type de logement. On n'offrait pas plus de deux concepts.
- La plupart des communautés possédaient peu de ressources locales pour l'élaboration de concepts de maisons personnalisés ou pour l'adaptation des concepts existants. Les listes d'attente nuisent à la participation de la communauté à la conception des maisons.

RECHERCHES RECOMMANDÉES

Un facteur qui revenait constamment pendant les entrevues, était le manque de données d'analyse ou de documents pour étayer les expériences et les histoires personnelles. Il existe de nombreuses occasions de recueillir et de traiter l'information permettant de faire ressortir les inconvénients et les avantages d'intégrer les matériaux et les concepts locaux au logement des communautés.

Analyse économique des matériaux locaux

Une analyse des coûts réels de construction résidentielle à l'aide de matériaux locaux (rondins et ballots de paille) donnerait une meilleure idée des avantages afférents. Cette analyse détaillée devrait porter sur les coûts et les avantages au niveau environnemental, social et culturel, en plus de tenir compte de la perspective et de l'approche holistique des Autochtones.

On procéderait aussi à une analyse du cycle de vie (effets environnementaux ascendants et descendants d'un produit, d'un projet ou d'un processus au cours de sa durée entière : extraction et traitement des matières premières, fabrication, transport, utilisation, réutilisation et entretien, recyclage et élimination finale).

Analyse institutionnelle des obstacles à l'innovation

En règle générale, une minorité seulement de communautés présente des exemples locaux d'utilisation de matériaux ou d'élaboration de concepts. Il existe probablement de nombreuses raisons qui expliquent cette situation, mais certains commentaires recueillis en entrevue ont indiqué la présence possible d'obstacles institutionnels : absence de codes du bâtiment spécialisés portant sur les matériaux de construction novateurs comme les rondins et les ballots de paille, structure de financement qui ne favorise pas l'innovation ou la planification à plus long terme. Ces préoccupations n'ont pas été décrites entièrement pendant les entrevues et pourraient faire l'objet d'un examien plus approfondi dans le cadre d'une recherche qui porterait sur :

- l'évaluation des guides des règles de l'art sur la construction à l'aide de matériaux novateurs afin de les intégrer aux programmes de logement;
- l'intégration, dans le cycle courant de l'évaluation de programme, des critères de conception employés pour le logement des Autochtones. On pourrait inclure des questions comme : Le profil du parc construit dans le cadre des programmes correspond-il à celui de la collectivité? Comme la majorité des logements sont construits à l'aide de fonds versés dans le cadre d'un programme, le profil doit correspondre aux besoins en matière de logement de la communauté.

Élaboration de principes de conception d'habitations et de plans

Les préférences des participants à la recherche pourraient servir à élaborer de nouveaux concepts de logements ou à adapter des concepts existants. D'une culture à l'autre, on n'a relevé aucune différence majeure au niveau des préférences en matière de conception, ce qui indique qu'un seul ensemble de principes de conception ou qu'un petit nombre de plans de base suffirait. Les principes de conception et les plans pourraient ensuite être offerts aux communautés ainsi qu'à leurs entrepreneurs. Enfin, on pourrait décrire plus en détail, l'expérience des deux communautés où les concepts ont évolué avec leur système de production de logements et diffuser cette information comme modèle de pratique exemplaire.

Directeur de projet : Phil Deacon

Rapport de recherche : *Aboriginal Housing: Local Materials and Alternative Design Needs and Preferences*

Consultants pour le projet de recherche :
Centre for Indigenous Environmental Resources (CIER), Winnipeg, Manitoba

Recherche sur le logement à la SCHL

Aux termes de la partie IX de la *Loi nationale sur l'habitation,* le gouvernement du Canada verse des fonds à la SCHL afin de lui permettre de faire de la recherche sur les aspects socio-économiques et techniques du logement et des domaines connexes, et d'en publier et d'en diffuser les résultats.

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1. EXECUTIVE SUMMARY

From October 2001 to October 2003 the Centre for Indigenous Environmental Resources conducted research for the Canadian Mortgage and Housing Corporation (CMHC) study *Aboriginal Housing Assessment: Community Design Needs and Preferences and Application of Local Materials*.

A total of 14 communities across Canada participated in the design component of the research and shared information on housing in their community and its ability to meet their cultural needs and preferences. In general, Aboriginal housing does not currently meet these needs. Participants in the study suggested design changes that would be better suited to the local culture and climate. Common culture design considerations include: increasing overall space in the house to allow for larger families, extended families and large group gatherings; flexible space (e.g., one large central room instead of smaller, separate dining and living room); a back-up heat source; fire exits; allowances for outdoor space and outbuildings (e.g., shed, smokehouse, greenhouse); closed porches and mudrooms; design for the needs of children; design for the needs of the elderly; and housing for single people. People would like to live in houses that are consistent with their local needs and would like to participate in the design their home.

The local materials component of the research included site visits and interviews in four Aboriginal communities, as well as telephone interviews with other communities and Aboriginal businesses and organizations, and literature/Internet review. Based on the community's use of local materials or the strong possibility for use of local material for the majority of the houses logs, straw bales and bricks were chosen. One First Nation in North-western Ontario using logs; two Indian reservations where residents have build straw bale houses in Montana, USA; and one First Nation in southern British Columbia where local clay resources and a brick plant are on the reserve participated in the research. Logs and straw bales were found to be the most applicable to other Aboriginal communities, assuming access to local, sustainable resources and labour. In all cases, the communities felt that the use of local materials and local labour for housing construction resulted in economic, social and environmental benefits.

2. INTRODUCTION

2.1. Background: Aboriginal Housing in Historic Context

We know that when indigenous peoples the world over first built structures, they were designed in a way that respected culture, climate and place. The structures, including dwellings, were designed for the cultural needs of the inhabitants, stood up to the demands of the local climate, and were constructed of materials local to the place. Some communities also designed their structures to align with the heavenly bodies.

> "The provision of housing for Aboriginal people on reserve is a major issue that provides a challenge for everyone involved in the issues of governance, administration, procurement and construction of residential facilities in First Nation communities. The life span of the existing housing stock, along with the potential for new family formations, creates an enormous demand for new housing units, as well as raising the quality on the existing stock."
>
> – Brandt (2000)

Until just over a century ago, the dwellings built by the first peoples of Canada were as diverse as the peoples themselves and the lands on which they lived. Culture, geographic location and material availability influenced all dwellings, from the long-house to the tipi to the igloo. Just as the igloo would not have been appropriate on the Pacific Coast nor the tipi in the Arctic, a dwelling designed for an urban Canadian culture and constructed with "typical" materials from a far distance away is not appropriate for Aboriginal on-reserve housing today.

Today, according to Indian and Northern Affairs Canada, there are over 600 First Nation communities in Canada consisting of 52 nations or cultural groups. Most of these communities have fewer than 500 residents. In 2001, about 423,000 people were living on reserves – about 146,500 on reserves located in urban areas; 189,000 in rural areas; 87,500 in remote regions and special access areas (an area where a community has no year-round road access to supplies and equipment, a pool of labour and government services) (Office of the Auditor General [OAG], 2003). These figures speak to the present-day cultural and geographic diversity of Aboriginal peoples and communities in Canada; a diversity that is indicative of the varied Aboriginal housing needs and preferences across the country.

For the past four decades, housing in First Nation communities across Canada has been made available primarily through transfer payments from the federal government. Faced with long waiting lists for housing, most First Nation governments have felt compelled to maximize the number of units built, which usually means building lowest cost 'boiler plate Reserve-style' houses. The bulk of these housing units have been, and continue to be constructed based upon urban designs and imported materials. In remote communities the material freight costs can comprise half the cost of the housing unit. Factors of overcrowding, house design limitations (e.g. lack of storage for winter clothing

and equipment; lack of room for processing of traditional foods; designs not suited to efficient fuel wood heating), and low-end (cheap) building materials combine to reduce the life expectancy of housing units. This results in high maintenance costs and contributes to problems such as indoor mould.

> "Only half of the Native households on reserves live in housing which met or exceeded the standards for both suitability and adequacy." (Spurr, Melzer and Engeland, 2001)
>
> "In general, the housing stock deteriorates more rapidly on reserves; this is attributed mainly to sub-standard construction practices or materials, lack of proper maintenance, and overcrowding." (OAG, 2003)
>
> "In the past, Aboriginal communities have criticized the sort of housing that has been built through government programs. In general, such criticism was usually related to the appropriateness of housing designs and technical components or the types of materials specified for construction of the housing. House designs offered with programs, though not compulsory, were considered too "suburban" – designed for the south and not suitable for a northern, Aboriginal lifestyle. Other designs were considered not durable enough or not properly designed for the long harsh winters in northern communities." (Canada Mortgage and Housing Corporation [CMHC], 2001)

Aboriginal communities can choose the type of housing provided it is modest and in keeping with the particular social housing program. However, communities are still faced with a dilemma that designs offering more appropriate housing may cost more to construct. While communities could build more suitable but expensive housing they could end up with fewer units. To make the best decisions, communities need to be able to assess the benefits that different housing designs may offer. (CMHC, 2001)

Another concern of Aboriginal communities has been that that housing dollars have often been spent to import construction materials when local materials when local materials are readily available. Construction of housing is often the largest economic stimulator in a community and there may be opportunities in some communities to use resources and capital more effectively within the community. While some communities do have natural resources that can be used for housing construction, the economic viability of doing so has not been clearly defined or explored.

Information concerning past experiences of incorporating Aboriginal design considerations and using locally available materials is useful to both Aboriginal communities and those involved in housing delivery programs. Canada Mortgage

and Housing Corporation (CMHC) is addressing these issues by supporting this research project on design needs & preferences and the application of local materials for Aboriginal housing.

2.2. Purpose of Study

The overall purpose of this study is to: (1) understand, assess and evaluate housing design needs and preferences of participating communities, and (2) facilitate the transfer of knowledge from First Nations who have implemented or experimented with the use of local materials for home building to First Nations and federal / provincial policy and program officials who are unaware of these alternatives.

2.3. Scope and Objectives of Study

For the purposed of this study, 'Aboriginal' includes First Nation, Métis, Inuit and Native American communities. For the local materials component of the study research was restricted to Aboriginal communities housing. This includes communities with and without reserve status. This report does not contain information about how to design a home to be more culturally appropriate not how to build a home using the local materials described in these pages.

This objectives of the study are to (1) communicate the housing design needs and preferences of Aboriginal peoples from seven distinct geographic regions across Canada and (2) document and disseminate information about how communities have successfully made use of local materials – timber, clay and straw bale – to construct on-reserve housing.

2.4. Organization of Report

This draft report on the use of local materials is organized into eight sections. A brief description of each of the sections is provided below:

Executive Summary

Introduction

Background information to the Aboriginal housing study is provided, the purpose and objectives are defined, the purpose of the report is explained and the organization of the report is outlined.

Methods

The overall study approach and the methods used to conduct the study and analyse the results are described.

Assessment of Design Needs & Preferences

The findings from the interviews and focus groups that were held in selected Aboriginal communities are presented in this section.

Use of Local Materials

This section presents the findings from the local materials case studies, advantages / disadvantages, lessons learned and commentary on sustainability of the material. This section concludes with an analysis of the applicability of these three materials to other regions of Canada.

Conclusions

Conclusions from the study are summarized in terms of significance or research finding for communities and for policy makers. This section also includes a short list of recommendations for further research.

References

References cited in the preparation of this report are listed. Additional references and websites consulted during the preparation of the report are also provided.

Appendices

All relevant appendices are contained in a separate document.

3. METHODS

3.1. General

3.1.1. Overall Approach to Study

The overall approach to the research for both studies contained within this report is outlined in Figure 3-1.

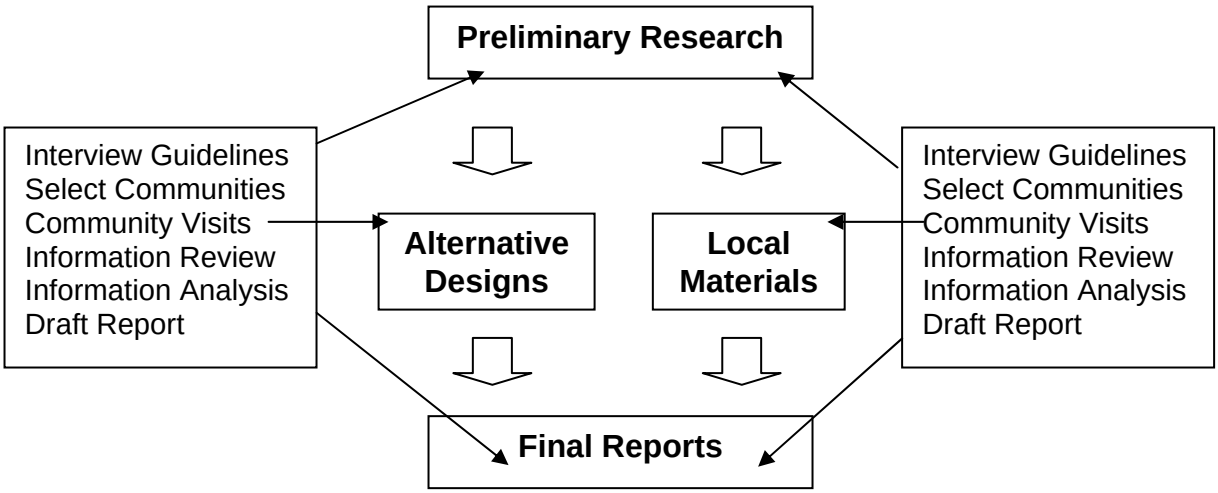

Figure 3-1: Approach to Aboriginal Housing Study

A literature review and contact with government agencies, First Nations and First Nation political bodies allowed for a preliminary scoping of Aboriginal housing issues, the range of materials in use and some aspects of design considerations. This preliminary review resulted in our selection of local materials and communities to be included in the next stage of the study.

Through continued research and communication with interested First Nations, a final list of communities using local materials for housing and alternative housing designs were selected for inclusion in the study.

3.1.2. Change to Original Project Scope

The results of the preliminary research resulted in the need to modify the project scope and workplan in April and June 2002. These changes nevertheless maintained the integrity of the research and the overall project goal. They were proposed to, and approved by, CMHC. The shortage of examples of Aboriginal housing using local materials and / or communities willing to share their local

design experiences resulted in a reduction in the number of communities that were included in the research. In the revised scope, 42 communities were contacted (six per region). From this list, two communities in each of the seven geographic regions used by the study team (as identified in Native Peoples and Cultures of Canada, Alan D. McMillan, 1988) were visited. Given the limited number of communities utilising local designs in their housing, the purpose of the questions to guide the interview process during these site visits was modified to focus on the housing design needs and preferences of those interviewed.

To enhance the local material component, literature review (i.e. documentation of similar work) became a more important research method. Modifications to the approach used in the local materials component of this study were minimal. CIER's preliminary research suggested that Aboriginal communities were using three local materials (log, clay and straw bale) and these became the focus of this component of the research.

3.2. Community Design Needs & Preferences

3.2.1. Approach

The literature review began with research to find communities that may be using alternative designs for housing. This review also took into account the need to represent the seven identified cultural regions of Canada.

Aboriginal communities were contacted to determine their interest in the research and were provided introductory information about the Project (see Appendix 1) and when requested were provided with the interview questions prior to the site visit. The communities then contacted the Project team members to inform us of their willingness to participate, and site visits were scheduled. Detailed written notes and / or audio recordings of the interviews, photos and personal impressions were gathered during the site visits to document the information. After each site visit was completed, this information and literature research was synthesized, reviewed and analyzed.

3.2.2. Initial Research

The literature review conducted for this research consisted primarily of searches of library collections – including the Canada Housing Information Centre and the Centre for Indigenous Environmental Resources Library – and the Internet. Some materials were also obtained from the personal files of Mr. Ray Gosselin.

3.2.3. Case Study Selection

The participating communities were selected based on their interest in and willingness to participate in the research, and on representation of the seven cultural areas in Canada. Given the change in the scope of the design research actual implementation of alternative designs was not a requirement. A willingness to discuss the issues and housing design needs and preferences of the community was sufficient.

3.2.4. Community Site Visits

Tall Grass Prairie and CIER staff visited the participating communities between February 2003 and November 2003. Approximately two days were spent in each community and visits were planned at the convenience of the community. The interview involved two separate groups who often participated in the interview together: home-users (i.e. member(s) of the community and/or Elders); and the community housing administration (i.e. chief, council member, housing director and staff).

CIER's subcontractor, Tall Grass Prairie, performed nine of the community visits. Tall Grass Prairie was unable to complete the research and did not provide CIER with complete data for its nine site visits. Consequently there are some inconsistencies in both the quantity and quality of the data presented in this report. The interviews conducted with Westband First Nation and Okanagan Indian Band were conducted during the same meeting and the participants do not identify themselves on the audio recording. The information gathered during the interviews for these two communities of the Plateau cultural region of Canada is therefore presented as one. These communities do have close political and traditional ties so it is not likely that any information has been lost. CIER is able to report the experiences of the communities visited by our internal research staff in more detail and with a greater photographic record. CIER staff performed the five remaining community visits.

Tall Grass Prairie developed questions to guide the interview process, which was then recorded. Questions and the topics of discussion on these recordings were used by CIER to generate consistent interview questions for the remaining five site visits. Brian Porter of Two Row Architects, Six Nations, Ontario reviewed CIER's questions and provided additional suggestions and comments. The questions were grouped into the following categories: Experience with Design, Design Needs and Preferences, Traditional Building Methods and Designs; and Housing Authority. The CIER interview guide is provided in Appendix 2.

Photographs from the site visits were provided on CD. The information gathered during in-person interviews for each of the 14 communities is provided in Appendix 4.

3.2.5. Analysis of Findings

The audio and written records of the interviews were used to compile a summary of the housing experiences and design needs and preferences for each community visited. The comments related to alternative designs were categorized as Aboriginal cultural or general housing needs wherever possible. For example, design suggestions relating to finishing materials is considered a general preference whereas the desire for a large working space for crafts is considered primarily a cultural preference.

Similarities and differences among the suggested alternative designs were analyzed to create a summary of cultural design needs and preferences. Regional differences in alternative design that were specific to cultural or climatic regions were identified, where relevant.

3.3. Application of Local Materials

3.3.1. Approach

The approach to the research on Aboriginal community use of local materials was consistent with the overall approach to the study outlined in Section 3.1 above, with some modifications as we progressed to reflect the changing information our research provided. A literature review began with research into communities that use local materials in housing construction. This review also generated a preliminary list of local materials on which to focus the research and potential site visits.

The literature review was followed by telephone calls to the communities identified to verify if they were currently building with local materials. Three communities were identified for primary research (i.e. site visits) and two additional communities were also identified for primarily secondary research case studies. After the three building materials were chosen and a short list of communities using these materials identified, an information package was sent to the communities. The information consisted of the project summary (Appendix 5), a one-page summary of the project partners (CIER and Tall Grass Development), and the interview guidelines. The communities then contacted us and informed us of their willingness to participate, and site visits were scheduled. Detailed written noted and / or recordings of the interviews, photos and personal impressions were recording during the site visits to document the information. After each site visit was completed, this information and literature research was synthesized, reviewed and analyzed.

3.3.2. Initial Research

The literature review conducted for this research consisted primarily of searches of library collections – including the University of Manitoba, the Canada Housing Information Centre and the Centre for Indigenous Environmental Resources Library – and the Internet. Some materials were also obtained from the contractor's files and the personal library and files of Mr. Rodney McDonald.

The majority of the information reviewed was dated from the mid 1990s to the present. CIER staff conducted the literature search and review between February and October 2002.

3.3.3. Case Study Selection

Scheduling community visits began in October 2002 and was completed in November 2003. The Band Office was contacted by phone and CIER staff introduced the project to the Chief or Councillor with the Housing Portfolio. Suitability of the community as a potential case study (i.e. with housing built from local materials) and their interest in participating in the research was determined. Oftentimes several phone calls were required to ensure that the person was available to discuss the project and potential site visit. A database was used to track all contact with Aboriginal communities and organizations.

This component of the research required more time than was expected given the difficulty we encountered in finding Aboriginal communities using local materials. For example, preliminary research that had indicated that some First Nations were using local materials, was found to be outdated when we contacted the communities directly. Some of these communities had changed their practices in recent years, or had a very limited sample size of only a few homes constructed of local materials. As indicated in the previous section, First Nations whose use of housing materials was consistent with the objectives of the research and were interested in participating in this research were sent project information.

3.3.4. Community Site Visits

CIER staff visited four First Nations in Canada and the U.S. to learn about the use of local building materials for Aboriginal housing. CIER project staff had previously developed questions to guide the interview process (Appendix 6). This list of questions ensured that all research questions were addressed and provided consistency during the interviews. In some situations additional topics were discussed when suggested by the interviewee. The questions were grouped into the following categories: Materials; Preparation; Construction; Sustainability; Birth of the Initiative; and Reflection.

Contacts in each Aboriginal community were established before the site visit and follow-up occurred after the visit. Dates of the site visits, the community members interviewed and the structures observed are described in Table 3-1. Approximately two days were spent in each community. Information obtained from the in-person interviews and discussion with Aboriginal community members are provided in Appendix 7. Photographs from the site visits are provided on CD.

The Chief, Housing Officer, community contact person or homeowner was provided with a copy of the questions prior to the site visit.

Table 3-1: CIER Contacts For Local Material Research

Material	Community	Personal Contact	Personal Interview	Literature Review	Site Tour
Timber / Log Construction					
	Nibinamik First Nation	Roger Beaver (Chief) Richard Beaver (Band Councillor) James Beaver (Band Councillor, Housing Portfolio) Lawrence Yellowhead (Deputy Chief) Randy Wabasse (Family Resource Worker).	YES	YES	March 4,5 2003
	Sandy Lake First Nation	Joe Meekis (Band Councillor) David Laurant (technical advisor)	YES	YES	NO
	Eagle's Nest Log Industries	Cliff Shakley (Nooaitch First Nation Robert Savignac, Executive Director of the International Log Builder's Association	YES	YES	NO
	Manitoba Keewatinowi Okimakanak (MKO) *	- Laurel Gardiner - Mike Anderson	YES	YES	Meeting May 12, 2003
Clay					
	Sumas First Nation	- Chief Beatrice Silver, - Lindy Beaver (Band receptionist and past Sumas Clay Products employee) - Mr. Dave Topper, Manager of Sumas Clay Products	YES	YES	January 13, 14 2003

Material	Community	Personal Contact	Personal Interview	Literature Review	Site Tour
Straw bale **					
	Northern Cheyenne: Northern Cheyenne Community Centre (Muddy Hall), Northern Cheyenne Literacy Centre (Chief Dull Knife College) Bear Quiver family residence	Otto Braided Hair and Jeff Hamby (community centre) Joan Hantz and Jeff Hamby (literacy centre) Martha Bear Quiver	YES	YES	January 23,24 2003
	Crow Nation: Crow Agency Community Hall	Curtis Yarlott (St. Labre Indian School) Jack Joyce (teacher).	YES	YES	January 24 2003
	Kanata 2000 Demonstration Home (Kahnawake First Nation)	NO	NO	YES	NO

* MKO, an organization of Chiefs from 27 First Nations in Northern Manitoba, is currently working on the planning phase of a local lumber project. The Building Sustainable Workforces project was initiated by MKO staff to examine and initiate the use of local timber resources for home building on Manitoba reserves.

** The notes from the Montana interviews (in the case of straw bale construction) were rewritten in increased detail with supplementary information provided by Associate Professor David Riley at Pennsylvania State University and Robert Young at Red Feather Development Group.

4. ASSESSMENT OF DESIGN NEEDS AND PREFERENCES

4.1. Introduction

Numerous housing needs assessments have been conducted on Aboriginal housing in Canada. In the CMHC report *Planning Study of Native Northern Communities* (1997) written by Donna Diakun and Gino Pin, an examination of the success of existing planning and housing practices for Aboriginal communities in the North West Territories presents a range of solutions to the unique housing problems of specific cultures in the North, which contain key findings applicable to other culture areas.

According to the literature and based on historical analysis, each community is unique in its history and needs, and requires specific planning and housing solutions rather than globally applied standards. Externally initiated housing has been typically concerned with functionality and has neglected the social, cultural and environmental needs of the people, and their traditional values and knowledge. Global application of housing options, without adequate consideration of cultural, social and climatic concerns, has resulted in housing that does not suit the needs and preferences of Aboriginal people in Canada (Diakun and Pin, 1997).

This component of the Aboriginal Housing Assessment of Design Needs and Preferences and Use of Local Materials Study investigated the housing design needs and preferences of fourteen Aboriginal communities. Communities were chosen based on their interest and their location within a framework of cultural areas, based on the book by McMillan Native Peoples and Cultures of Canada (1988). The seven identified culture areas and the major language groups are:

1. Arctic (Inuktitut);
2. Eastern Sub-arctic (Algonkin, Cree, Blackfoot, Malecite, Micmac, Montagnais, Naskapi, Ojibwa, Ottawa, Saulteaux);
3. West Sub-arctic (Beaver, Carrier, Chipewyan, Dene, Dogrib, Hare, Kutchin, Slavey, Tutchone, Tahltan);
4. Northeastern Woodlands (Algonkian, Iroquoian);
5. Plains (Assiniboine, Blood, Blackfoot, Blood, Cree, Piegan, Siouan);
6. Northwest Coast (Bella Coola, Wakashan, Salishan, Tsimshian, Haida, Tlinget, Kutenai); and
7. Plateau (Kutenai or Kootenay, Lillooet, Okanagan, Shuswap, Thompson, Chilcotin and Carrier).

Two communities were selected from each of the seven regions. The information shared by these communities during the community visits and interviews is presented as case study data. It should not be assumed that the information in this report provides generalizations of the various cultural areas' views on housing design and preferences.

The cultural areas and communities that were visited are outlined in Table 4-1.

Table 4-1: Participating Communities by Cultural Regions

Cultural Area	Communities Visited	Interview Dates and Responsibilities	Participants
Arctic	Hamlet of Gjoa Haven (NU) Teltit Gwich'in First Nation (NT)	Tall Grass Prairie, February 25, 2003 Tall Grass Prairie, March 12, 2003	Assistant Manager of Gjoa Haven Co-op, the Housing Officer, a Hamlet Councillor, a community member and a translator. Two Band Councillors, the Band Manager, the Community Coordinator, and an Elder.
Eastern Sub-Arctic	York Factory First Nation (MB) Kawawachikamach Naskapi Nation (QC)	CIER, August 19, 20, 2003 CIER, August 27, 28, 2003	Housing Project Manager, Housing Coordinator, homeowner, and Elder Chief Ennis, the Housing Officer, the Director of Public Workshops, the Financial Property Manager, a homeowner, and an Elder.
Western Sub-Arctic	Liidlii Koe First Nation (NT) Fort Simpson Metis Nation (NT)	CIER, November 13, 2003 CIER, November 12, 2003	Chief Keyna, two Housing Inspectors, Housing Manager, and an Elder. Metis local Manager, 2 homeowners, 2 Elders

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Cultural Area	Communities Visited	Interview Dates and Responsibilities	Participants
Northeastern Woodlands	Membertou First Nation (NS)	Tall Grass Prairie, March 19, 2003	Housing Supervisor, Housing Assistant, Receptionist, construction Manager, Engineering Advisor
	Six Nations (ON)	CIER, October 28, 2003	Director of Six Nations Housing, Housing Council Chair, Housing Inspector, Environment Officer, 2 homeowners
Plains	Piapot First Nation (SK)	Tall Grass Prairie, May 14, 2003	unknown
	Pasqua First Nation (SK)	Tall Grass Prairie, April 27, 2003	Housing Manager, two Housing Councillors, two community members, an Elder
Northwest Coast	Tsawout First Nation (BC)	Tall Grass Prairie, March 26, 2003	Housing Manager, Health Director, Village Maintenance worker, community member / private consultant, home care / elder care worker.
	Kitsumkalum Indian Band (BC)	CIER, August 13 and 14, 2003	Housing Coordinator, building consultant, 4 homeowners
Plateau	Westbank Indian Band (BC)	Tall Grass Prairie, February 19, 2003	Community member
	Okangan First Nation (BC)	Tall Grass Prairie, February 19, 2003	Housing manager, community member

4.2. Compilation of Community Information

This research uses the experiences and information provided by interviewees to understand the housing needs and preferences of 14 Aboriginal communities in Canada. A summary of each of the 14 community visits is provided, by cultural region, in Appendices 6.5 through 6.11.

The interviews conducted also provide insight into the general housing needs of Aboriginal peoples in Canada. It is interesting to note that among the seven different cultural regions that were included there are many housing design preferences that are similar. Differences in needs relate primarily to climate and the different cultural activities (e.g. fishing versus hunting) practiced in the community. The severe climate in the Arctic and Sub-Artic regions and the northern reaches of the other cultural regions were the cause of most of the design needs related to climate. The research also provides insight into many different approaches to providing housing. There were a limited number of questions related to housing authority and not all communities discussed this issue in much detail, however those that did illustrate some very different, and apparently very successful, housing programs.

4.2.1. Summary of Community Needs and Preferences

One very important difference between Aboriginal and non-Aboriginal housing is the length of time that people will reside in their house. There are very few Aboriginal communities with a housing market, where houses are bought and sold. When houses change hands in an Aboriginal community, this exchange remains between Band (versus non-Band) members. As a result, when a person receives a house on their reserve it is likely that they will reside in that house for the majority of their remaining life. In combination with the federal funding for housing and a general lack of personal funds applied to housing, this has several implications. Whereas a non-Aboriginal family, or family off-reserve would likely move to a larger home as the size of their family increases, this is not an option in an Aboriginal community. Similarly, as non-Aboriginal people age and their housing needs change many would renovate their homes (e.g. add railings on stairways) or move into single-story homes or apartments. Aboriginal elderly people have few such options. While there are programs on reserve to adapt housing, this was still a common compliant of the research participants.

Housing in Aboriginal communities is generally provided to suit the current needs of the residents. One of the research participants noted that when he reviews a housing application for a young couple with a new baby for example, he knows that their family will grow but he cannot allocate housing to suit these future needs. Many of the housing concerns of the communities that participated in this research relate to the fact that people cannot adapt their living space to meet the needs of a growing family.

Options for larger houses should be provided, including the possibility of basements that can be used as living space. If CMHC does not choose to support finished basements then the remaining living area should be sufficient such that the basement is not needed. Where the climate and landscape permits, CMHC should consider making basements optional and allowing crawl spaces for maintenance access only. Design options should also include closed porches or mudrooms that are large enough to accommodate a deep freeze or to double as a small workroom. These are clearly necessary in many communities to meet both cultural (e.g. storing game, gathered berries) and climatic needs (removing and storing winter/hunting clothing).

Finally, there is a significant need for funding to renovate existing homes to meet the current and future needs of existing residents. The Residential Rehabilitation Assistance Program (RRAP) and other funding available through CMHC provide a means of dealing with overcrowding. Nevertheless, the challenges associated with ensuring homes are adequate in size for the occupants were raised in every community, suggesting the funding programs available are not meeting the needs of the communities.

4.3. Analysis: Pattern of Common Elements

The people who participated in this research had many housing complaints and ideas for solutions that relate to design. These comments suggest more appropriate housing design processes and physical structures. Some of the design needs are cultural in nature, while others are more general.

4.3.1. Cultural Design Needs

Many of the design needs of communities relate to larger family size and the family orientation of Aboriginal culture and lifestyle. Most participants in this research had more than two children and had households comprised of more than their immediate family. In several cases adult children were living with their parents; elderly parents were living with their children; two families were living together in one house; relatives were visiting for long periods of time. Virtually all of the houses were unable to accommodate such large numbers of people, resulting in cramped living conditions, and occasionally, feelings of inadequacy and distress at the inability to provide for family and friends. A lack of space was a concern in all of the communities. A discussion of the common design needs and preferences that relate to Aboriginal culture is provided below.

4.3.1.1. <u>More space</u>

Most houses in Aboriginal communities are built for four people, yet most family homes have more occupants. Generally, there are not enough bedrooms for each person to have their own space. In some cases additional bedrooms have

been created by altering floor plans without increasing the overall size of the house. People would like to live in houses that are larger, include more bedrooms and have more than one washroom.

Basements are often seen as a means of providing additional living space. As there is no government funding available to finish basements, most are not well insulated or heated. Many basements have mould problems. Some people would like to eliminate basements completely and opt for only a crawl space while others would like to include the basement as a viable living space.

Additional storage and cupboard space as well as space to accommodate a deep freeze is needed in many communities. In particular those that hunt, fish, gather berries, and can foods need more space to store this food. Food is often given to people in the community who are in need, is supplied during community gatherings, and is used for personal consumption. Housing designs need to consider storage of large quantities of frozen and canned foods.

4.3.1.2. Flexible space

The need for interior space that is flexible was mentioned in many of the interviews. The standard floor plans that divide a house into small room and hallways does not allow for comfortable family gatherings and in many cases creates rooms that are not even large enough to allow the members of the household to eat together. People would like the option of houses that use a more open concept floor plan that, for example, places the kitchen, living room and eating area within one large room. Such a large room could also be used for feasts, ceremonies, crafts, and other cultural activities.

4.3.1.3. Outdoor space and outbuildings

For many communities, cultural activities occur out of the house. Many people expressed a desire for outdoor space associated with their house and / or for outbuildings, such as sheds and smokehouses. Outdoor space is needed to set up poles to pound and dry animal skin, to dry fish, to accommodate a large table (that may be partially covered) for cleaning fish, preparing berries, etc. In addition to sheds and smokehouses some communities would like to have a workroom that is heated and attached to the house.

4.3.1.4. Closed porches and mudrooms

The need for an entrance to the house that is separate from the main door is a concern for communities that experience cold and / or wet weather. A closed porch or mudroom protects the living space from adverse weather (e.g. wind gusting into the house) and helps to improve the energy efficiency of the house. It also provides space for people to enter the house, clean up after working

outside, removed outdoor clothes and shoes. This helps to keep the house free of mud, dust and the chemicals that adhere to these particles.

4.3.1.5. Back-up heat source

Communities in northern Canada and remote communities are concerned with the reliability of their heat source. Many people who have a fireplace or a woodstove are very pleased to have this back-up source of heat and those who don't often expressed this desire.

4.3.1.6. Fire exits

Several communities are concerned about the potential safety of their homes and their ability to escape during a fire. In some cases shifting of the foundation and house has resulted in windows and doors that open with difficulty or not at all. People would like to be confident that there are adequate fire exits in their homes.

4.3.1.7. The needs of children

The general lack of space in the houses resulted in a lack of space for children to play, study and socialize away from the parents. In addition, the small number and size of bedrooms in the homes that requires children to share rooms was seen as a problem, especially for families with children of opposite sexes, and as children aged. People would like these homes to include indoor and outdoor places for children.

4.3.1.8. The needs of the elderly

Elderly Aboriginal people who are living in single-family homes experience the same challenges as all elderly people. Steep stairs to enter the house, steep and occasionally winding stairs to the basement and/or second floor (where one exists), narrow hallways and doors, small washrooms, and storage areas that are out of reach create difficulties for elderly people, many of whom have walking aids. In Aboriginal communities many people remain in their first home for the duration of their lifetime and funds for renovations are non-existent or scarce. Consequently as people age, they do not often move into new houses, or renovate their current houses, to suit their changes needs. This makes the lack of appropriate designs for elderly people particularly noticeable.

In some communities elder / senior citizen facilities have been built that provide group housing, home care or community living options. As is the case in many cultures, some of the people interviewed for this research agreed with this approach to living while others did not. Aboriginal culture is historically community oriented and many communities remain so and in some communities a co-op type housing where elders have individual suites and a common living

and eating area is being considered. Nevertheless, there were some of the Elders who participated in this research who believed this to be a loss of independence that they would never embrace.

4.3.1.9. Housing options for single people

In many Aboriginal communities people are on waiting lists for housing and can remain on the list for several years before receiving a house. Generally these houses are given to families and it is difficult for single people to obtain a house. In some cases single people do not qualify for the waiting list. This results in young people leaving the community or increased crowding problems as they continue living with family or relatives to remain in the community. Some communities have started to build multiplex housing units to provide apartment-type living situations for single people. Many people interviewed emphasized the need to design houses that meet the needs of single people in their communities.

Other issues of housing design that are not necessarily related to culture are discussed below.

4.3.2. General Design Needs

4.3.2.1. Colour and Flooring

People often have minimal input into the colours used in their houses (e.g. for exterior siding, for counter tops). Similarly there is minimal input into the choice of flooring (e.g. carpet, tile, hardwood). In some cases this related to health and mould associated with carpet. People would like to be involved in the choices of these finishing materials.

4.3.2.2. Better housing material quality and construction

Many people were concerned that the materials that were used to build their homes were not of sufficiently high quality. Some people also believe that their houses are not structurally sound. According to the interview participants many of the houses require significant repairs soon after they are built. There is also a feeling in many communities that the houses are not properly built or inspected according to the national building code.

4.3.2.3. Consideration of climate

For communities in northern climates, efficient heating systems and triple pane windows would improve the efficiency of the house. Construction that minimizes the potential for shifting and cracking of walls and foundations would prevent the need for some housing maintenance and repairs. The location of doors and windows should also consider the climate and be situated to maximize the efficiency of the house. In some communities, for example, the doors and

windows are on the north side of the house, indirectly in line with the north wind, and out of line with the sun, respectively. People would like to have efficient and effective housing designs that suit the local climate.

4.3.3. Lessons Learned

For many people it was difficult to answer the questions that were included in the interview. There are a few potential reasons for this. In several communities it appeared that people had not thought about their housing needs in a proactive way. This is not surprising given that most communities are not a part of the decisions-making process related to housing. Another challenge to gathering appropriate information is that, in most cases, people do not recognize their lifestyle or activities as being cultural or traditional. Instead of asking people to identify what would meet their cultural needs, it would likely have been more appropriate to ask them what activities they practice and participate in and what type of space they need to do this.

Many people had complaints about their current housing design or the housing program in their community and from these it is possible to derive what the design needs and preferences would be.

4.3.4. Next Steps

4.3.4.1. Housing Design

CMHC and the Aboriginal governments should promote the application of alternative housing and planning models based on traditional knowledge and heritage rather than standard Western / southern norms. The housing designs that are available to Aboriginal communities need to be expanded. There is an opportunity to develop housing typologies that suit the needs, lifestyles and culture of the people. These designs could also be used in non-Aboriginal communities for people who are looking for an alternative to the conventional single- family suburban house.

A database with a profile of the houses in the community, created by and managed by the housing office would be useful and would provide the local and federal government with an understanding of the work that has been done, or is required, for each house. This would prevent a loss of information and consistency as people involved in housing in the communities change responsibilities. In Kawawchikamach Naskapi Nation, locally developed housing software is used. According to CMHC, computer software is available to communities to create this type of database. Such a system was not referred to in most communities, suggesting that there needs to be an increase in the awareness of this tool in First Nations.

4.3.4.2. Housing Programs

Six Nations of the Grand River and the Naskapi Nation of Kawawachikamach have innovated housing programs that use bank or First Nation government mortgages, housing committees, local department of public works, and local housing policy documents to administer housing. One of the significant differences related to housing in these communities is that more people own their houses, as compared to other Aboriginal communities where members are tenants. According to the research participants, this sense of ownership has helped to increase community pride and created a desire to maintain and care for houses.

Detailed case studies of these communities and an understanding of the step-by-step approach used to establish these successful housing programs would be very useful for both CMHC and other communities.

4.4. Conclusions

Virtually every person who participated in this research has housing design needs and preferences that are not being met. All of the 14 communities possess a desire for better housing and housing design. Currently, there is distrust in the communities regarding the quality of their houses and the interest of the federal government and First Nation Housing Councillors/Program Administrators in affecting change.

There are many design needs (an open concept room for the kitchen / living room / dining room, more bedrooms, a second washroom) that could be addressed through relatively simple changes to housing floor plans. Other design needs related to the climate could also be addressed through changes to housing blueprints that allow for closed porches or mudrooms, windows that face south, and doors that do not face north. CMHC and the architects should work collaboratively with the communities early in the design phase.

Houses in Aboriginal communities need to be designed to meet both the current and future needs of residents, given that most people will remain in their house for their lifetime. Housing design needs to consider larger families, people sharing their homes with other family members, and future needs of aging residents. As the members of the community and homeowners age, the ability to renovate houses that were not built to include the needs of elderly people will become an issue. These needs should also be included early in the design phase and many of the needs (e.g. minimal stairs, stairs with railings, wider hallways) could be incorporated into all new homes.

Overall housing efficiency, durability, and health implications of both the materials (insulation, windows, flooring) and the appliances (e.g. furnace, deep freeze) used in the houses should be considered. Given that most people are unable to

renovate their homes or replace the interior design or their appliances, providing a house that is efficient and durable is essential. Appropriate and efficient methods of heating, cooling and ventilation for the local climate should also be included.

There needs to be more input by the community into the planning and design of their homes. This must be an ongoing process that is open to all members of the community. One future option could be to continue to work with the Aboriginal communities who participated in this study to develop alternative designs. Aboriginal housing design meetings could be held with community planners, architects, the Aboriginal government representatives and interested community members to develop a list of housing priorities and create floor plans and housing blueprints. These housing options could then be included as some of the pre-designed houses available for communities to choose.

In addition communities should work with the federal governments to create Community Plans that ensure that housing, and all other developments, are consistent with the community's vision for itself, meet the needs of the community, are in appropriate locations, and consider water and waste management. In many communities houses are located far from one another and from other facilities, such as schools and green play spaces for children.

5. APPLICATION OF LOCAL MATERIALS

5.1. Introduction

Three types of local building materials were chosen for study, based on communication with First Nations, Aboriginal agencies and government departments regarding the successful use of local materials by Aboriginal communities. They were also chosen to reflect a range of materials that are available in different geographic and climatic regions of Canada. The building materials selected for research were timber (log), clay brick and straw bale.

Researchers visited four Aboriginal communities in Canada and the United States to learn about the use of local building materials for Aboriginal housing. Contacts in each Aboriginal community were established before the site visit and follow-up occurred after the visit. Approximately two days were spent in each community.

5.2. Timber

5.2.1. Overview

Local timber is used for housing in Nibinamik First Nation and has been used in the past in Sandy Lake First Nation in northwest Ontario. Information on Nibinamik First Nation was obtained during a site visit. Log housing initiatives by Sandy Lake First Nation and Eagle's Nest Log Industries were researched through the literature and phone conversations but were not visited. At the time of writing, Manitoba Keewatinowi Okimakanak ("MKO") is working on a local lumber initiative for its member First Nations in Manitoba. Information about MKO's initiative was obtained through telephone conversations and during the attendance of a meeting of the project partners.

The Nibinamik First Nation was visited on March 4 and 5, 2003 to research the use of local timber in Aboriginal housing. Lisa Hardess of CIER interviewed Roger Beaver (Chief), Richard Beaver (Band Councillor), James Beaver (Band Councillor, Housing Portfolio), Lawrence Yellowhead (Deputy Chief) and Randy Wabasse (Family Resource Worker). The site visit included observations of log homes and a tour of the local area.

Phone interviews were conducted with Joe Mekis (Band Councillor) and Laurant David (technical advisor) of Sandy Lake, Robert Savignac (executive director) of the International Log Builder's Association and Cliff Skakley of Eagle's Nest Log Industries. Rodney McDonald, of CIER, spoke with Laurel Gardiner (Income and Security Reform Project Manager) of MKO and attended a meeting of MKO local lumber initiative project partners in Winnipeg on May 12, 2003.

5.2.2. Case Studies

Four timber case studies were identified and researched. Nibinamik First Nation in northern Ontario was visited to learn about the successes and challenges using local timber for housing. Log housing initiatives by Sandy Lake First Nation (Ontario), Eagle's Nest Log Industries (British Columbia) and Manitoba Keewatinowi Okimakanak ("MKO") were researched to provide additional information but were not visited. Information on the use of local timber was obtained though interviews and site observations (for Nibinamik First Nation) and through communication by telephone and document review.

5.2.2.1. Nibinamik First Nation

Community Profile

Nibinamik First Nation (No. 241) occupies the Nibinamik Indian Settlement on Nibinamik Lake in northwest Ontario. This community is approximately 350 air km north of Nakina and 185 air km northwest of Pickle Lake. There is no year-round road access to a service centre and, as a result, experiences a higher cost of transportation. As of April 2003 the total registered population was 396 with 320 on own reserve, 13 on own Crown land and 53 off reserve. The native language of this community is Ojibway. This First Nation is affiliated with the Matawa Tribal Council and offers employment opportunities in administration, housing, education and health.

Nibinamik First Nation is located in the Big Trout Lake Ecoregion of the Boreal Shield Ecozone. It is marked by cool summers and cold winters. The annual mean temperature for Pickle Lake -0.5^{o}C with annual minimum and maximum temperatures of -6.2 and 5.1^{o}C, respectively. The average annual precipitation is 733 mm with 499 mm of snow and 272 cm of snow. Its dominant vegetation is coniferous forest, characterized by a closed canopy of black spruce along with some white spruce, balsam fir and trembling aspen.

The First Nation was officially recognized in 1975 and since that time approximately 80 log homes have been built in the community. Some four to five homes are built per year and this provides local employment during the tree harvesting and home construction periods. At time of writing, there was a housing shortage in the community with approximately 20 homes on the waiting list. Due to a forest fire in the early 1990s, the community is no longer harvesting trees for log homes. The fire caused significant damage to nearby forest and suitable trees are now more than 15 km from the community. This has increased the cost of building with local materials and according to Chief Beaver, this is one of the reasons log homes are currently not built.

Using Local Materials: The Decision-Making Process

Community members have been involved in the decision to use local logs for housing to varying degrees. The First Nation government office provides housing, however, individual community members have also built their own homes privately. In all cases, the proximity and abundance of suitable trees and the availability of local knowledge and skill factors into the decision to build with local logs. The community built entirely with local logs for approximately 2 decades followed by a decision by the then Chief and Council to stop building with local material in lieu of prefabricated building materials. Whether or not the community was in favour of this decision is unclear.

While this decision prevented the First Nation government from building with local materials, individuals in the community continued to build log homes privately. Currently, according to the interviewees, the majority of the community would be in favour of using logs again, if the logs were available. According to the current Chief, most people in the community place greater importance on cost effective shelter than whether or not the shelter meets current building codes. In the Chief's opinion, log homes meet the requirement of cost effectiveness. If logs become available again in the future (or increased travel to find suitable trees becomes more economical) Chief Beaver plans to survey the community for interest in log homes. He and the Councillors interviewed believe that the community will want to build with this local material.

The Local Material

Members of Nibinamik First Nation have been building log houses since before the 1970's. Spruce logs were chosen for building material because they were locally available; the community is surrounded by boreal forest. Trappers in the community also developed experience building log homes using local spruce trees during their time spent on the trap lines.

According to the interviewees, most trees for logs or timber are cut from the nearby forests while others are harvested from further away, on Crown lands. Nibinamik does not currently have reserve status and as a result does not have access to CMHC funding for construction of new housing, as would a First Nation on reserve (according to the Chief, the status of the First Nation may change by the end of 2003). Consequently, none of the local resources are currently considered available for use by the First Nation. CMHC has funded extensions and renovations to existing log homes to increase house size and allow for running water. Funding for the actual building of log houses has been provided primarily by INAC, and minor capital investments by the First Nation. In the past, Chief Beaver obtained work permits to harvest the trees from the Ontario Ministry of Natural Resources. He noted, however, that in other cases those in need of housing have simply cut wood near the community to build their own homes.

For houses that are built by the First Nation government, local crews of one to five people are hired for a three-week period to cut the trees using their own chain saws. The work involves tree cutting, bark peeling and cutting the trees to an appropriate size (depending on the type of log home being built). Harvesting takes place in the winter months from March to April, and can continue into the summer when it becomes easier to prepare the logs. In the past crews cut trees every year, but due to decimation caused by fire this has not been possible recently. Houses built privately by community members may require as few as three people to build the structure, depending on the building design chosen.

On average, crews of three people harvest the spruce trees used for log homes. A foreman marks suitable trees (e.g. 18 cm diameter and straight) and two people cut the trees using chain saws. Log homes do not require the use of a sawmill and depending on the design can be use whole, or cut to the required length. The need for suitable trees for log homes results in a selective cutting approach. Green logs twist and settle as they dry which creates cracks and shifting post construction therefore dry logs are desired, so after being cut down, the trees are debarked and left standing to dry for approximately two months. Local people are hired to transport the logs from the forest using their own vehicles or boats. If the community needs rough lumber or planks for construction, the logs are run through one of the two locally-owned portable sawmills. This operation can occur in either within the community or in the forest.

Nibinamik operated a local sawmill that was used to cut logs into rough timber and planks (2x4, 2x6 and 1x6) but it was destroyed during the 1999 fire. There are no plans to replace this sawmill but Chief and Council are considering a HDP40 portable sawmill. This sawmill has 40-horse power capability and can cut longer pieces of timber than a less powerful sawmill. It also has a hydraulic arm that can transport logs. The community currently has two mobile sawmills (11 and 13 HP) with one owned by the First Nation and the other owned by the local store. The First Nation would like to hire a manager to run its sawmill, and there is interest in the community for this. At this time, however, the community does not have sufficient funds to create this position. While the sawmill is not necessary for log home building, it allows the community to use local materials (for example, trees not suitable for log home construction) for other non-structural uses.

Design/Construction with the Local Material

In 1975 and 1976, non-Aboriginal contractors and builders (funded by the Ontario government as Nibinamik is not a reserve able to access federal funds) came to Nibinamik to build the school, health centre and other buildings. According to Chief Beaver, local labour was also used and many people in the community learned building skills from this experience. These skills have been passed on to others in the community since that time. Nibinamik First Nation has two official

building instructors (Chief Beaver and Sandy Yellowhead) who have taught in the community and in nearby communities. Chief Beaver recently went to Webique to train a First Nation tourist outfitter in log building techniques and to help build log houses for this operation.

Log house building skills also exist in Nibinamik through the knowledge of those who have used logs to build their own homes and trappers' cabins for many years. The skill is being passed on to the youth of the community as they work in crews with more experienced log builders. The community has also received funding to train younger members in log building through Aboriginal Human Resource Development Agreements, run by Human Resources Development Canada (HRDC) and channelled through a local group, Mamo-Wichi-Hetiwin Employment and Training (based in Constance Lake First Nation with branch offices in Timmons and Thunder Bay), that reviews proposal and allocates funds. Nibinamik has had successful Residential Housing Construction Training proposals in the past using local trainers to provide training to five to six people per session.

Housing construction is completed by both the First Nation government and by individuals within the community. Sandy Yellowhead and Roger Beaver are the two local building supervisors. Mr. Yellowhead designed and supervised the construction of the majority of the residential houses in the community. Chief Roger Beaver worked as a contractor in the past and built many log homes using his own designs and workers he hired and trained. He took building and carpentry courses in Thunder Bay and followed Ontario building codes when he built his homes. Chief Beaver noted that building codes are not always used and many people have built their own homes without this training. This can occur when community members build their own houses with private funds and labour, and are therefore not subject to First Nation government control or approval. The design and construction of a number of log homes without consideration of building code requirements (for example, structural requirements to ensure capability to withstand snow loading) has decreased their life to between 20 and 25 years.

As mentioned, one log house requires three to five people to construct including one foreman and up to four labourers. Typically, one house involves 18 to 20 weeks of work from harvesting through to site preparation and construction. According to the Chief and Band Councillors who participated in the interviews, the average cost of one log house is estimated to be about $70,000. The Chief noted that the current total cost to build a house with lumber shipped from a building supplier is $90,000 to $120,000.

There are four types of log construction used in Nibinamik: 1) vertical logs with a bottom notch; 2) horizontal logs with notches in the top ends; 3) alternate stacking; and 4) vertical stacking with concave shaping on the bottom. One log home built with horizontal logs requires approximately 230 logs. When the

community was first established houses were typically built in this fashion, as logs were abundant. According to Chief Beaver when the community was unable to access as many logs suitable for log homes, the construction design changed to primarily vertical log building. This vertical log with bottom notching design requires approximately 70 logs and requires more pre-cutting and nails (1 log requires a minimum of 5 nails). According to Chief Beaver, although the time required to build this type of log house depends on the skill and experience of the builders, it is faster to build than the other designs and can be built with a minimum of 3 people (typically 3 to 5). This type of log home is now the most popular in Nibinamik First Nation because of its lower resource and labour requirements and its ease and speed of building.

Many houses in the community are very small and contain extended families. Typically, there are two rooms with a common area. Some log homes have been renovated with extensions to create additional space. Other extensions were required when the community secured in-home water service in the late 1990s. As previously mentioned, CMHC has funded these renovations and extensions. Currently, due to the current non-reserve status of the community, CMHC does not directly inspect houses in the community. A housing inspector from the Tribal Council visits Nibinamik and sends his reports to CMHC. Chief Beaver noted that it is generally the electrical and plumbing systems that are inspected.

The sites for new houses also require preparation by clearing the land and removing stumps. If suitable, trees removed can be used for building. This work is very labour intensive and time consuming because heavy equipment is not available. For example, stumps are removed by inserting a piece of wood as a level and knocking the stump loose so that it can be hauled it away. This site preparation has the benefit of producing local employment.

New houses in the community have been built in the direction of the escarpment but cannot continue further in that direction at this time, due to the site contamination resulting from a mid-1990's fuel spill. This site will be cleaned-up in 2003. Consequently, the community has not been able to use this site for development until remediation is complete. Following the clean up, Chief and Council will prepare a 20-Year Capital Planning Study for Indian and Northern Affairs Canada (INAC) in 2004, which will include an analysis of housing requirements. If there are logs available, Chief Beaver would like to survey the community for interest in log homes and believes that the community will want to build with local materials.

Outcome

When Nibinamik first began building log homes, government funding was not available and no building codes and standards were required in their construction. Local materials were used since before 1975 because they were nearby and available. Before the forest fire, trees were considered abundant and houses were built on an as-needed basis. The forest was therefore not managed as a resource. Tree harvesting and house construction occurred on a regular basis since the mid 1970s with four to five houses being built each year, until very recently. The majority of the community housing consists of log homes, some of which are over 25 years old. The last log house was built in 1999. In recent years private individuals have continued to build their own homes out of logs.

> "Nibinamik First Nation is one of a kind, [the log houses are] culturally appropriate and tie in with nature…it demonstrates who we are, as Aboriginal people, and we are keeping our identity"
>
> – Band Councillor

The community's ability to build housing using local materials was virtually destroyed when a devastating forest fire swept through the area in 1992. Approximately 50,000 ha of forest were burnt. The 15 km now required to travel from the community for suitable logs for houses is considered by the First Nation as too far, and will result in a housing process that is not economically feasible. This, in combination with the decision of a past Chief to commit the community to purchasing prefabricated building materials, has resulted in few new logs homes being built since the early 1990s. This has resulted in the First Nation purchasing lumber from an external supplier to build houses. Some homes are built of rough lumber from local material that is run through the local portable sawmill. Most of the homes, however, are now wood-frame with plywood siding, constructed with cut lumber flown into the community. Chief Beaver noted that these wood-frame houses are more expensive than log houses largely due the cost of the materials and shipping required.

With access to training initially via non-Aboriginal contractors and local building contractors trained at college, and subsequently via information transfer between generations, Nibinamik has access to a relatively well-trained labour source. Prior to the fire, selective logging techniques required to access appropriate logs would likely have resulted in sustainable harvesting of the nearby forest.

Despite the fact that the community is not currently able to use local logs for housing, the interviewees provided the following advantages and disadvantages to the use of this material, based upon their experience with the previously-built log houses.

Advantages:

- Properly built log houses perform well and last a long time. The ability of the house to handle the cold, snow loads and other conditions depends on the skill and training of the building supervisor.
- Building log houses creates more employment than the use of pre-fabricated building materials. More people in the community were employed during log home construction, which increased personal pride.
- Local materials cost less than building materials shipped by air or transported to the community by winter road.

Disadvantages:

- In the absence of properly trained supervisors and builders, log homes can have problems with drafts and cracks, and may not perform optimally.
- Supply of suitable logs is dependent upon sustainable harvesting practices, replanting of new trees to replace those harvested, and fire management.
- Many homes in the community use open wood stoves or open fuel drums for heating, which creates dust and results in respiratory problems – especially in houses with cathedral ceilings. Drop ceilings are being used and log stoves are encouraged. (The First Nation recently bought 20 wood stoves to sell in the community.)

The Chief provided the following advice to other communities interested in building with logs: If there are good stands of spruce trees (or other species suitable for log home building) within a reasonable distance, a community could build log houses using their own materials. Training should be acquired if no one in the community is experienced in log house construction and general house construction (roofs, windows, foundations etc.).

The community should compare the different methods of building log houses to meet local physical and cultural needs. For example, more than double the amount of logs are required for horizontal log home design. Culturally, as mentioned, in Nibinamik, people do not want the exposed logs in the interior of the house and prefer paneling instead.

5.2.2.2. Sandy Lake First Nation

Community Profile

Sandy Lake First Nation (Ne gaaw saga' igan) is located approximately 227 km northwest of Red Lake in northwest Ontario. Sandy Lake First Nation has a land base of 4.3 ha and an on-reserve population of approximately 2,000. About 83% of the population speak Oji-Cree. An elected Chief, a Deputy Chief and eight councilors govern the independent First Nation. An appointed Elder's Council

attends First Nation Band Council meetings to witness and advise on decisions and resolutions.

The community is accessible by air year round and by winter road when conditions permit. It has a 1,220 m gravel runway with lights providing night and year round access with aircraft. The main community is located on the northwest end of Sandy Lake, on the southern shore of the river mouth feeding into Finger Lake on Cobham River.

Sandy Lake currently has two new schools, an elementary school and high school with an annual enrolment of approximately 700 students. There is an adult learning centre providing distance education. There is also a Police Service, Nursing Station, Community Development Services Corporation, several Christian churches, Fire Hall, Motel and various community facilities and businesses.

Sandy Lake First Nation is located in the Lac Seul Upland Ecoregion of the Boreal Shield Ecozone. Warm summers and very cold winters characterize the Ecoregion. The annual mean temperature for Pickle Lake 0.8^{o}C with annual minimum and maximum temperatures of -4.7 and 6.1^{o}C, respectively. The average annual precipitation is 634 mm with 455 mm of snow and 191 cm of snow. This Ecoregion is classified as having a subhumid mid-boreal ecoclimate. The dominant land cover is coniferous forest with some limited areas of mixed forest. Characteristic vegetation includes white spruce, balsam fir and black spruce with some trembling aspen and balsam poplar. Jack pine and black spruce are more common on moderately well- to imperfectly drained sites.

Sandy Lake was part one of several communities included in "*The Innovative Housing Initiative*" funded by Department of Indian Affairs and Northern Development (1997). The demonstration project in Sandy Lake included use of on-site materials and local labour. Sandy Lake First Nation government manages housing projects and also managed the innovative housing project.

The Local Material

According to the First Nation's technical advisor, a good source of logs (spruce) is readily available in the surrounding area. A group within the community is currently looking at the possibility of building with local materials but are considering lumber (versus logs). There is an operating sawmill in the community, owned by one of the members of the First Nation.

Sandy Lake is not currently building log homes, therefore details pertaining to preparation and construction were not discussed. Information on the *Innovative Housing Project* is available from Indian and Northern Affairs Canada (INAC). At time of writing, Sandy Lake shipped housing packages for the majority of its house building. There was a housing shortage in the community with

approximately 100 people on the waiting list, suggesting a need for up to 50 new houses.

Outcome

The *Innovative Housing Project* resulted in five new log houses in Sandy Lake. Each house used local materials and labour. The logs were not left in their natural form but were cut and squared by local workers at a local sawmill operated by the Sandy Lake Development Corporation. The Chief and Council estimated the cost of each house at $55,000, which did not include $6000 for air transportation of some construction materials.

In their final report, the Department of Indian Affairs and Northern Development concluded that logs houses were cost effective and created local employment opportunities (Cote and Byam, 1999). After this project, the community continued to built with logs for two years. Six logs homes were built each year for a total of twelve logs homes. In total, there are 25 log homes built during and after the project.

According to councillors, the First Nation government made a decision to stop building log homes in the late 1990s due to apparent high costs. The cause of the failure of the INAC project to result in a long-term housing opportunity for Sandy Lake First Nations is unknown and likely complex. Technical problems also developed, relating to lateral shrinkage of the logs and airflow between the logs. The community does not record the cost to build log homes separately from the cost to build prefabricated homes (according to the technical advisor all housing funds are grouped as one) and it is therefore difficult to perform an accurate cost analysis of the different building methods.

The technical advisor noted that the houses built during the INAC project were of a design that required trimming the logs on three sides prior construction and was therefore labour and skill intensive. This project did not include a training component. In his opinion, this likely also contributed to the short-term success of the project. The absence of capacity building in the community is clearly a contributing factor to the lack of sustainability of the housing project.

Sandy Lake First Nation has therefore stopped building log homes. Housing packages are brought in to the community and provide employment for approximately 30 local people during the summer months. The people interviewed were uncertain if this method of building houses provided more or less local employment than would log home building.

5.2.2.3. Eagle's Nest Log Industries

Company Profile

Eagle's Nest Log Industries (ENLI) is a 100% First Nation industry; a joint venture involving Cooks Ferry, Coldwater, Siska and Nooaitch First Nations. The company representative who participated in this research was from the Nooaitch First Nation. The company was created to meet the need for community housing, a community desire for log homes and the availability of local materials. It is now successfully building log homes both on and off reserve, and recently participated in a 'matching' session in Austria and trade missions with CMHC in Seattle.

Members in the First Nation communities involved in ENLI have received 2.5 years of training in log construction through an association with the International Log Building Association. There is a lot of interest in the communities, and with buyers, in having a crew of workers that can build a log home from start to finish (foundations, carpentry, log-home building, finishing work etc.) to create a full log-home package. ENLI and the First Nations would like to move in this direction. In addition to building homes, ENLI also produces wooden tables, signs, log furniture and speciality items, such as staircases.

The Local Material

The logs used for home building must be straight and uniform. The First Nations involved in ENLI have forested land on reserve and have used their own trees – primarily "fir" - for building. Dead, dry standing trees are preferable to green wood to minimize shrinkage and settling that can result in shifting, cracks and drafts. Tree moisture content of 18% or less is desired for log-home building.

ENLI has a 'tree agreement' with Weyerhaeuser Canada and Tolko Industries that allows it to hand pick logs for building. Trees harvested on-reserve are exchanged with the forestry companies (often two reserve trees for one suitable log) for premium house-building logs, including dry logs. ENLI has also gone to the open market for some materials to satisfy particular specifications for log quality.

According to Robert Savignac, Executive Director of the International Log Builder's Association, many people are not aware of what is required to build a log house. A log house cannot simply be built by stacking logs on top of each other and cutting notches, but must be to code and built with proper techniques. He has worked with many First Nations to help provide training for log home building. Mr. Savignac stressed the requirement for training in good overall building practices (roofing, windows, vapour barriers, etc.) in addition to log building training. The learning curve for log building is relatively short and most

people can learn appropriate skills in three months. True apprenticeship courses require four years of training, which indicates a considerable amount of learning is possible. Nevertheless, a trainee can become a good craftsperson in a relatively short period of time, without high level literacy and math skills.

Outcome

With the help of the International Log Building Association, ENLI has worked to have the wood they use for building graded and assessed for compliance with building codes. This has allowed ENLI to pursue CMHC funding for log building. The First Nations have planned 24 new subdivisions for their members, with six houses planned for 2003. Five of the six homes are log homes. ENLI is planning to build an additional six homes per year for the next three years and is confident that many of these will be log homes. Cliff Shakley, with ENLI, noted that the First Nations have long housing waiting lists and that the majority of the people on the lists want log homes.

According to ENLI the benefits of log homes include the increased longevity of the houses (100 to 200 years versus 50 years for a conventional wood frame house and as low as 12 years for some pre-fabricated homes), and the durability of interior logs. The company also uses local resources either directly or to access premium logs, and provides employment to community members. In addition, there is pride and cultural benefits associated with the use of local, natural materials. The ENLI website states: “our log homes are built to reflect the traditional values of our people using local resources and providing us with a healthy living environment.” (www.eaglesnestloghomes.com)

5.2.2.4. Manitoba Keewatinowi Okimakanak

Manitoba Keewatinowi Okimakanak (MKO), an organization of Chiefs from 27 First Nations in northern Manitoba, is currently in the planning phase of a First Nation housing project. MKO initiated the Building Sustainable Workforces Project to examine and initiate the use of local timber resources for home building on Manitoba reserves. The project partners are MKO, Indian and Northern Affairs Canada, Manitoba Education Training and Youth, Manitoba Aboriginal and Northern Affairs, Human Resources Development Canada, Keewatin Community College, Manitoba Conservation, Manitoba Hydro and Canada Mortgage and Housing Corporations.

The project team is working to address perceived and real impediments to the use of local lumber for homebuilding in northern Manitoba First Nations. For example, impediments identified by the project team include: concerns about the moisture content in lumber, the lumber not being graded for home building use, and the belief that the lumber must be planed on all four sides.

The impetus for this initiative was, in part, the findings of the Auditor General's Report: Federal Government Support to First Nations – Housing on Reserve which commented explicitly on the need for housing in First Nations in Canada. For the past 25 years, MKO First Nations have expressed their concern about the dire state of housing in their communities, and have expressed their interest in attempting to remedy this situation through local timber harvesting and sawmill production for both housing construction and non-structural uses of timber.

Training is a key component of the MKO Centre of Excellence for Northern Housing. MKO plans to train five to six people in each interested community. The decision to train a relatively low number of community members in timber housing construction components is based largely on MKO's belief in the need for economic development and diversification within First Nations. Also, as the timber harvesting is intended primarily for local needs (versus a full-scale logging operation) a small number of operators is sufficient. Depending on the needs of the First Nation, training will include harvesting, milling, grading and / or construction. Not all communities will require sawmills and although it is now possible to purchase smaller, relatively inexpensive machines ($30,000 to $40,000) MKO will help communities to economically evaluate this need.

MKO plans to develop a local lumber use "toolkit" that includes relevant best practices as a resource guide for communities interested in using local lumber for housing construction. These best practices will also be consistent with international commitments (e.g. of sustainable development) and concerns of the First Nation governments (e.g. to avoid large-scale clear cutting).

Local lumber in participating communities will not be used exclusively for housing but would be available for other lumber needs. For example, all gradable lumber would be used for housing while un-gradable lumber would be used for non-structural uses (storage, fencing, docks etc.). The Central Forest Products Association, in Winnipeg, oversees all grading of lumber in Manitoba. MKO plans to include training on grading and lumber certification within its program, however, even with certified "gradermen" available within the community, certification of the local sawmill is also required. Despite the inclusion of grading training, grading of local lumber is no longer a requirement for houses built with CMHC assistance. In the late 1990's CMHC accepted the use of rough lumber in housing construction (therefore eliminating the requirement to edge or finish plane lumber) so long as it meets dimensional and moisture requirements.

The goal of MKO for 2003 is to complete a pilot housing project with an interested community, conduct training, harvest local timber and use it to construct at least one house. According to MKO lumber advisor Brian Monkman, who visited various First Nations to discuss MKO's initiative, initial reactions of communities has been positive. To begin, MKO will work with St. Theresa, Wasagamach and God's River First Nations. As of May 2003, MKO was looking to include a planning team member with knowledge on the use of traditional

knowledge in forest management to contribute to God's River First Nation's existing preliminary sustainable forest management plan.In total, MKO hopes to work with five or six communities to pilot its First Nation Housing Initiative.

5.2.3. Advantages / Disadvantages of Logs

A summary of the advantages and disadvantages, as presented by the interviewees and derived via analysis is outlined here:

Advantages:

- Properly built log houses perform well and last a long time. Log homes provided excellent insulation and breathe well, resulting in more efficient heating and cooling of the house and a healthy interior air.
- Different designs of log-building are available, allowing for more variety in tree suitability.
- Log home building does not require expensive or technical equipment. Trees can be cut down and to site with a chain saw. Local trees can also be used to create lumber if a local sawmill is available.
- Building log houses can create more employment than building houses using pre-fabricated building materials. In the case of Nibinamik First Nation, more people in the community were employed during log home construction than when prefabricated building materials were used. The also helps to keep revenue within the community.
- Local materials cost less than building materials shipped by air or transported to the community by winter road.
- Minimal transportation of materials results in minimal associated pollution.
- There is pride and cultural benefits associated with the use of local, natural materials.

Disadvantages:

- In the absence of properly trained supervisors and builders, log homes can have problems with drafts and cracks, and may not perform optimally. The ability of the house to protect inhabitants from the cold, and handle snow loads and other conditions, depends on the skill and training of the building supervisor.
- The economic advantages of local materials decreases as outside labour must be hired. Without adequate capacity (or training opportunities) within the community the benefits to the community of using local materials may not be sufficient.
- Supply is dependent upon a sustainable source of trees, this may require sustainable management practices, including sustainable harvesting plans, replanting, fire management.
- Many homes in First Nation communities use open wood stoves or open fuel drums for heating, which create dust and results in respiratory

problems – especially in houses with cathedral ceilings. Drop ceilings are being used and log stoves are encouraged.

5.2.4. Lessons Learned

Logs can be a viable source of housing material given the right combination of access to suitable trees over the long-term, building skills and knowledge within the community, favourable environmental conditions and political and community support.

To ensure the sustainability of the log building process, a community must have a plentiful supply of logs that are relatively near the community. The community also needs the knowledge and skills (as per conventional construction) and the specific requirements for log building. Development of the capacity could provide economic opportunities for the members and both keep revenue within the community and reduce the cost of hiring non-local labourer. Without this internal capacity, a community cannot sustain local building initiatives.

- Specific log building techniques and an understanding of general house construction (windows, roofs, foundations etc.) is required to ensure the long-term success of the house. Training is an essential component of a housing initiative to ensure the long-term success of local building.
- As is the case in Nibinamik, local timber sources may be less expensive for the community than pre-fabricated materials transported from outside the community. Local materials require minimal transportation (and therefore create a minimum of pollution via transport).
- If managed correctly (i.e. not over-harvested) trees may provide a sustainable source of building materials.
- Training of local people provides local economic opportunities for the community that could be expanded to provide services off the reserve as well, as demonstrated by Eagle's Nest Log Industries.
- Environmental damage can create significant reduction in tree resources, as was experienced by Nibinamik First Nation.
- Building with local materials requires political will and support, both of the First Nation government and the community.
- In cases when the First Nation is reliant on funding for housing, the support of the funding agency is also required.

5.2.5. Sustainability of Logs

Trees can provide a sustainable resource for building materials. The need for a long-term supply of suitable logs likely results in selective harvesting techniques if a community is harvesting and keeping its own logs. In the case of the First Nations involved in Eagle's Nest Log Industries, the agreement with forestry companies results in an exchange of on-reserve trees. For the tree agreements, First Nations could cut and exchanges trees of all types, and then receive

premium logs for building. There is then perhaps a reduced likelihood of the communities using selective logging techniques (as they would if the logs were cut only for their housing needs). To ensure the long-term health of the forest, therefore, the communities needs to ensure that they harvest at sustainable levels. Environmental factors also influence the success of trees as a sustainable resource and forest management techniques may be useful in some situations (site preparation to encourage natural regeneration, seedling planting, fire control and management etc.).

Nibinamik First Nation appeared to be achieving a sustainable log building program prior to the forest fire. A small community surrounded by boreal forest with the internal skills required and political support resulted in log home building on a regular basis to meet the community's housing needs.

Chief Beaver and the Band Councillor who participated in this research believed that logs provided a sustainable method of building houses for Nibinamik First Nation. Prior to the forest fire, the materials were locally available, inexpensive to harvest and provided local economic opportunities. Unfortunately, since the 1992 forest fire the economic viability of using local logs for houses in Nibinamik has decreased as the suitable trees are at a much further distance. Since the fire, crews need to go approximately 15 km outside the community to find suitable trees.

Chief and Council would like to see logs used for homes in the future. According to the Chief, the following benefits of log house construction to the community in terms of sustainability are considered:

- Environmental – Trees are a renewable resource and were locally available, prior to the fire. Planning will ensure sustainability.
- Economic – Local building materials are free, particularly if sustainably managed. Labour and expertise are available. Revenues from building houses stay in the community.
- Social / Cultural – There is local pride in using own materials for the community. Building with local skills and labour increases capacity within the community. Skills can be and are passed on to future generations ensuring a local work force.

5.3. Clay Brick

5.3.1. Overview

To learn about the successes and challenges of using local clay and clay bricks for housing, CIER visited Sumas First Nation in southern British Columbia. The plant where the clay bricks are manufactured, Sumas Clay Products, and the location from where the clay resource is mined are both located on reserve land.

5.3.2. Case Study

5.3.2.1. Sumas First Nation

Community Profile

Sumas First Nation (I.R. No. 6) is located 10 km east of the District of Abbotsford along the lower slopes of Sumas Mountain and approximately 100 km east of Greater Vancouver. The name “Sumas” comes from a Halkomelem word meaning "big flat opening". The First Nation has a land base of approximately 235 ha. The developed portion of the reserve occupies approximately 39 ha or 16%, which includes lands, set aside for the Sumas Clay Products Plant. The balance of the reserve is either within the Fraser River flood plain or has slopes generally in excess of 15%.

Economic activities include Sumas Clay Products, agriculture, construction and proposed land development. On-reserve facilities include a community hall, cultural center, martial arts centre, band office, storage garage and school day-care.

> “When we use our own brick to build our own homes and buildings, we will offer reduced-price brick for other reserves and will welcome other First Nations to use our brick”.
> – Chief Silver

Sumas First Nation has recently elected a new Chief (Beatrice Silver) after many years with Chief Larry Ned. Beatrice Silver has been Chief since April 2001 and is very supportive of the plant and the use of brick. Chief Silver has a brick home located off reserve.

Sumas First Nation is located in the Lower Mainland Ecoregion of the Pacific Maritime Ecozone. The mean annual temperature for the area is approximately 9°C with a summer mean of 15°C and a winter mean of 3.5°C. Mean annual precipitation ranges from 850 mm in the west end up to 2000 mm in the eastern end of the Fraser River valley and higher elevations. Maximum precipitation occurs in winter as rain; less than 10% falls as snow at sea level but this proportion increases significantly with elevation. Mature native vegetation is characterized by forests of Douglas-fir with an understory of salal, Oregon grape, and moss.

Using Local Materials: The Decision-Making Process

Past Chief and Council were not in support of the brick plant or the use of bricks for housing. The type of houses desired by some community members (but not supported in the past) is that of a conventional house built with bricks. Chief Silver noted that members of the community have wanted to use brick in the past

but were not included in this decision process. Chief Silver and Mr. Topper noted that now, the majority of the community would like to use Sumas brick for their homes. Chief Silver believes that ideas and community plans should be presented to the community members for their input and support. According to Chief Silver, the people of Sumas First Nation are “finding their voices” and are beginning to participate in decision-making.

Chief Silver will be promoting the use of the community’s brick on reserve and for nearby First Nations looking for housing resources. She has met with CMHC to discuss their support of brick houses. She is working on a plan for building local brick homes approved by the community for presentation to the CMHC and Indian and Northern Affairs Canada before the next Band election in 2004.

The decision to use brick in the community centre was an initiative of the 6 people who also volunteered their time to build the centre after the community longhouse was destroyed by fire. The brick plant manager donated the brick for this building and the First Nation government were in support of this initiative.

The Local Material

Sumas First Nation has both fire clay deposits and a brick plant on its land. Fire clays have low concentrations of iron oxide, lime, magnesia, and alkalies that make this type of clay resistant to temperatures of 1,500 degree Celsius and higher and are more valuable than common clay. Local clay reserves are processed into clay bricks at the Sumas Clay Products brick plant. Despite this, homes in Sumas First Nation are not currently constructed with brick. The past Chief and Council did not support the use of brick for local housing and was not supportive of the brick plant. Consequently, there are no homes on reserve that are made entirely of brick. Many homes do have chimneys and foundations made from local brick and some have local brick garages.

The Sumas Band Office has been constructed with Sumas bricks. The Band office also has an interior wall made with Sumas bricks.

The Sumas First Nation Community Centre is constructed entirely with Sumas Bricks. Different colour bricks were used to create window frame designs and clay tiles line the floor.

Sumas Clay Products began in 1980 through the acquisition of Flex-Lox Industries. Flex-Lox clay product plant employed many member of Sumas First Nation and a community meeting resulted in the plan for 100% ownership of the plant. Difficult negotiations with Claybourn Industries, the supplier of raw clay material, were made easier when the legal council for Sumas First Nation discovered that several pieces of equipment were located on reserve land that had been subleased illegally. In addition, Claybourn Industries had to cross reserve land to access this equipment.

Sumas Clay Products is the only clay plant in British Columbia with beehive kilns and can make specialized brick products. The kilns are made of bricks and in the shape of a large room with a dome ceiling. Wet bricks are stacked inside for firing.

Sumas Clay Products is a 100% First Nation-owned enterprise with shares held in trust by the Chief Councillor of the First Nation government. The clay resources are on reserve land and royalties go to the community Trust Fund. The First Nation government and the Sumas Clay Products negotiate the cost of the clay. Sumas Clay Products currently employs 12 workers; however this number can change depending on the demand. At present, 2 of the worker are non-Aboriginal. In the past Sumas Clay employed more than 40 people, including employees from other First Nations in the Fraser Valley and non-Aboriginal people.

The plant has the potential for high capacity. Sumas Clay Products does not use an automated system, but cuts and stacks the bricks in the kiln manually. The number of kilns that are burned over the year provides a production measure. In 1987 100 kilns were burned, the most burned by the plant between 1982 and 2002. The kilns are an English design, complete with underground tunnels for circulation, are considered by the plant manager to be some of the best in Canada. Sumas Clay Products makes many different types of bricks, brick tiles and fireplace flue liners. The number of kilns has decreased in recent years, due in part to a decrease in the overall demand for brick and a shift in consumer preference towards cultured stone. In addition a significant buyer using the plant recently changed suppliers. Despite the high capacity available at the plant, in 2001 and 2002, only 16 and 15 kilns were burned, respectively.

Sumas Clay also produces some specialty clay brick and brick products and has the only beehive kiln in British Columbia. Sumas Clay also sells its brick internationally and sends 65% of its product to the United States and 3% to Japan.

The clay is harvested from the on reserve mine by blasting and drilling, using a local air track owned by one of the brick-plant employees, who is also a community Elder. Claybourn trucks deliver the large pieces of clay to the Claybourn plant for primary crushing. Pieces of clay can be as large as a car and the Sumas crusher is not designed for such large sizes. After primary crushing, local trucks transport the clay to the Sumas plant for secondary crushing. Occasionally Sumas plant picks up smaller pieces for secondary crushing directly from the mine. There are also occasions where the Sumas plant employees use their own trucks to transport large clay pieces to the Claybourn plant for crushing.

The work at the plant is often seasonal as wet weather causes slippery conditions in the mine and the clay cannot be harvested. In mild winters, such as

the one in 2002-03 work can continue throughout the year. In past years some staff would not work during the winter however with staff number as low as they currently are, most staff can work year-round.

Design/Construction with the Local Material

There are currently four trained bricklayers in the community. Lindy Silver trained at the Vancouver Vocational Institute and worked at the plant for several years before beginning reception work at the Band Office. In the past, if Sumas could not supply the training and labour locally, Aboriginal people from nearby reserves and local non-Aboriginal people were employed. When brick is approved for use in housing, Chief Silver hopes to initiate an on-reserve training program using local expertise and external support. She plans to contact colleges offering bricklaying courses to suggest the use of the Sumas Clay Plant and community as an on-site training location.

The community has a long waiting list for new houses. They are also in need of space and have reserve land on the other side of the Trans-Canada Highway where approximately 20 ha will be reserved for housing. Both Chief Silver and Mr. Topper, Sumas Clay Products plant manager, would like to see future homes built using brick. Sumas bricks will also be available to nearby First Nations, for local non-Aboriginal construction, as well as to current buyers.

The Sumas Nation's wooden longhouse was recently destroyed in a fire and the Community Centre is the temporary location for cultural activities until the new longhouse is built (using brick). Other activities at the Community Centre include Halqemelyn language classes, Christmas dinner and Alcoholics Anonymous meetings.

Six community members (4 Aboriginal and 2 non-Aboriginal people) built the Community Centre themselves with some help from the plant foreman and bricks donated by Sumas Clay Products. These people included current and past workers at the plant with bricklayer experience and training. The Centre was built over the rainy season and it took approximately three months to complete.

In addition to Chief Silver's plans for new brick homes there are also plans for a shopping mall, a convention centre with a casino and possibly a hotel on reserve lands. Chief Silver would like to see these projects constructed using 100% Sumas clay brick and has told the consultants working for the Sumas First Nation that this must be written into the contract. As a long-term goal she plans to negotiate for an overpass between the two reserve lands.

Outcome

Due to past political bias against the use of bricks and the brick plant, Sumas First Nation does not have residential houses on the community that are made

entirely of brick. Foundations and brick chimneys are relatively common and the Band Office and Community Centre are made entirely of local bricks.

Chief Silver plans to promote the use of bricks to the community and to CMHC with the goal of securing funding for brick homes in the community. According to Chief Silver, current CMHC houses are not performing well and many are cracking and shifting. It is believed that nearby mining could be contributing to this but neighbouring off-reserve homes do not appear to be experiencing the same problems. There have not been any structural problems with the Band Office, Community Center or nearby off-reserve homes that have been constructed using brick. Although there have been claims in the past that brick is too expensive a building material, Chief Silver does not agree given the local material and labour sources.

The Chief and Council plan to present the use of bricks for housing to the community to assess support for the initiative. Chief Silver is confident the community will be in favour of using their First Nation bricks. She believes community members should contribute to the decision-making that takes place in their communities. Regarding the use of local materials, Chief Silver encouraged other Aboriginal peoples interested in building with local materials to participate in the decisions made by Chief and Council to voice their needs and concerns. .

5.3.3. Advantages / Disadvantages of Clay

Analysis of the interviews and comments by Chief Silver and Mr. Topper resulted in the following list of advantages and disadvantages of local brick house construction to the community:

Advantages:

- Brick homes provide better insulation (cooler in the summer and warmer in the winter).
- Brick homes perform well over the long term and have low maintenance costs.
- Brick homes are healthier and have not experienced mould problems as have other wood frame houses.
- Using a local resource results is virtually zero transportation costs and pollution.
- Using local First Nation owned materials reduces the overall cost of building a house (especially when the plant is willing to donate bricks for housing to increase brick demand and advertise the product).
- Local employment opportunities exist at the brick plant and in construction if bricklayer training is secured. Training can be provided internally to a large degree if members of the community have experience in bricklaying.
- The First Nation could expand production and increase the marketing of their brick for export and use in neighbouring reserves.

- Using local materials provides a sense of pride to the community and a connection with land.
- Cultural benefits include "strengthening people spiritually by using and building our own materials and with our own hands" (Chief Silver).

Disadvantages:

- Brick homes may be considered 'luxury homes' by funding agencies resulting in difficulties in securing funding.
- Clay is a non-renewable resource.
- Creating bricks from clay requires technical capabilities and energy input (crushing clay, firing bricks etc.)
- Negative environmental impacts are a result of the brick plant (air pollution, depending on heat source, dust, water use etc.)
- The economic viability of the brick plant could decrease if future demand decreases, eliminating the source of bricks for the community.
- Even when you have a local resource, other factors may complicated implementation of ideas (politics, funding, skills).

5.3.4. Lessons Learned

The use of local bricks clearly requires a source of local (or economically viable) clay resources and the capacity to produce bricks. Alternatively, a reliable and inexpensive source of pre-made bricks – as would be available to nearby Aboriginal communities from Sumas First Nation – could also allow for a viable use of bricks for housing. Local capacity to work at the brick plant and bricklayers to build the houses decreases the cost of the houses, increases the economic opportunities for the community and keep revenues within the community. The requirement for political support is clear in the case of Sumas First Nation – a local material initiative for housing will likely fail if the Chief and Council are not in support.

- Bricks provide a strong building material that performs well over the long term.
- Bricks have good thermal capacity and are slow to lose or absorb heat.
- External bricklayers fees can be high. Local skills can decrease the cost of building brick houses and help to keep revenues in the community. Training is an essential components of a local materials housing initiative.
- A sustainable and economically viable source of clay and access to a brick plant in Sumas First Nation is a unique situation. This situation is not common among First Nations in Canada.
- In cases where the community relies on funding for housing, support of funding agencies is required in order for local materials initiatives to flourish.

- Building with local materials requires political will and support, both of the First Nation government and the community.

5.3.5. Sustainability of Clay

Chief Silver and Mr. Topper believe clay bricks could provide a sustainable source of building materials for Sumas First Nation. The clay reserves that exist apparently remain extensive. In the late 1980s the deposit being mined at that time was estimated to have a 25 year supply. The First Nation also has additional clay deposits on reserve land. Given the decrease in production levels since 1987, and assuming continued sustainable management the deposits could provide clay for many years to come. With proper management of the resource, the clay could be available to the community over the long term.

According to the past Chief Ned and employees of CMHC the cost of brick limits its use in houses. Chief Silver would like to see an economic analysis done comparing brick and standard CMHC houses. Both Chief Silver and Mr. Topper disagree with the view that brick is too costly given the local, First Nation-owned clay resource and brick plant. Local labour possibilities would help to decrease the cost of building. Even if non-local labour was required initially, local capacity and training potential is available.

Despite potentially higher initial costs (non-local bricklayers' labour costs would be high but so too would be carpenter labour costs), brick houses perform well over the long-term. They are warmer in the winter and cooler in the summer than a typical wood-frame house and are less prone to mould problems. Brick homes in the area have not experienced the shifting that wood-frame houses have.

With the resource and labour properly managed, therefore, bricks provide a sustainable source of housing materials for communities, like Sumas First Nation, with access to inexpensive clay and / or brick. A brick housing initiative is, therefore, believed to be economically sustainable by the current First Nation government.

According to Chief Silver, the following benefits of brick house construction to the community in terms of sustainability are considered:

- Environmental: bricks provide a very clean building material; as the bricks are on reserve land, minimal transportation is required reducing pollution caused by vehicles.
- Economic: the clay resource is owned by the First Nation and the labour required at the plant and to build homes could be provided locally, resulting in low cost of typically expensive components of house building. Brick homes provide high longevity and are therefore a good investment for the community.
- Social/Cultural: building with local materials and with local labour strengthens pride in the community (there is already community pride

associated with the new brick community centre). "It strengthens people spiritually by using and building our own materials and with our own hands" (Chief Silver).

5.4. Straw Bale

5.4.1. Overview

The study of the use of straw bales to construct homes in Aboriginal communities led the CIER researchers to two Native American communities in the state of Montana, USA and to the Mohawk community of Kahnawake, in Quebec.

Although all other components of this research project are in Canada, the researchers felt it was appropriate to include buildings in Montana, as the climate there is similar to some southern regions of Canada. The Montana examples are also unique because the buildings are the result of assistance provided to the communities by a non-profit organization and two universities – which have incorporated straw bale building in Native American communities into their curriculum.

The case studies described in this section include a home, a college campus building, and a community centre built on the Northern Cheyenne Reservation; a study hall built on the Crow Reservation; and a demonstration home called Kanata 2000 in the Mohawk community of Kahnawake, in Quebec. The case study buildings on the Northern Cheyenne and Crow reservations were visited by the researchers, whereas information about the case study in Quebec was obtained from printed materials and conversations with community members.

Since straw bale buildings may not be as well known to the reader as buildings constructed with timber (logs) or bricks, the next five sub-sections provide a brief history of straw bale building in North America, a description of the evolution of straw bale building activities in American Indian communities, and the initiatives and organizations/institutions supporting these activities.

5.4.1.1. Building with Straw Bales – Description of the Process

The components of straw bale homes are very similar to conventional homes built in Canada. Like conventional homes, straw bales homes have a basement or foundation, a roof, interior partition walls (in some cases built with lumber and drywall), standard windows and doors, wood truss roof (in most cases) and all the conveniences of conventional homes. The only real difference is that the exterior walls are constructed using straw bales versus traditional building products (wood, concrete, brick) and the interior side of the exterior walls is finished with stucco, giving the inside of the home an earthy adobe look. If it was not for the thickness of the exterior walls and stucco on the interior it might be hard to tell at first glance that a straw bale home is in fact a straw bale home.

Straw bale homes come in all shapes and sizes, from bungalows of modest size and budget to two story homes to sprawling ranch houses. The most popular structural design for a straw bale home, and also the easiest to build is the load-bearing design. With this design the exterior straw bale walls carry the structural load of the roof. Other structural designs include post-and-beam infill and box-beam infill. Straw bales are also used to build outbuildings such as garages and sheds.

The exterior straw bale wall has three main components: the straw bales, wire mesh and stucco. The straw bales are stacked, usually seven bales high for a bungalow style home, and tied down securely using an anchor of various sorts. A wire mesh is then secured to both the exterior side and the interior side of the straw bale wall (Figure 5-1).

Figure 5-1: Straw Bale House in Construction

The wire mesh helps the third component of the wall adhere to the bales. This third component is the stucco. Typically, three layers of stucco are applied to both the exterior side and the interior side of the straw bale wall. Once the stucco hardens, it is the stucco that acts as the primary support structure of the wall, with the bales providing the insulation value.

For a modest size home the bales can be stacked in one day with a crew of about 20 semi-skilled to non-skilled people. Each of the three layers of stucco can be applied in three consecutive days, with the roof requiring about one to two days to build. Doors and windows can be installed in one or two days. Thus, with a healthy workforce of semi-skilled and non-skilled individuals, once the foundation is in place, the exterior walls can be built and the home enclosed (roof, windows, doors) in about one week, including the finishing of the interior of the perimeter walls.

For comparison, the time to build and enclose a home built with conventional lumber is about four weeks. This includes building the stud walls, insulating the walls, attaching a vapour barrier and wire mesh, applying stucco to the exterior, installing windows and doors, constructing the roof, installing the drywall to the interior of the perimeter walls, taping and drywall, and priming and painting the drywall. Also, skilled carpenters can only do much of this work; there is little room for the homeowner or community members to become involved.

One of the advantages with straw bale construction is that it is low-tech enough that individuals with little or no home building experience can help with the construction of the home.

For a detailed description of building with straw bales we encourage the reader to consult the many reports, web site and books available on the subject, including The Straw Bale House by Steen, Steen and Bainbridge (1994).

5.4.1.2. Building with Straw Bales – A Brief History

Utilizing straw bales for building in North America dates back to the 1800s, particularly after the steam-powered hay/straw baler came into common use in the 1890s. Non-Aboriginal settlers in northwest Nebraska used straw bales to build structures in response to a shortage of trees for lumber. They used straw bale construction to build homes, farm buildings, schools, offices and grocery stores (U.S. Department of Energy, 1995).

> "Straw is a viable building alternative, plentiful and inexpensive. Straw bale buildings boast super-insulated walls (R-50), simple construction, low costs, and the conversion of an agricultural by-product into a valued building material. Properly constructed and maintained, the straw bale walls, stucco exterior and plaster interior remain waterproof, fire resistant, and pest free. Because only limited skill is required, a community house-raising effort can build most of a straw-bale house in a single day. This effort yields a low-cost, elegant and energy-efficient living space for the owners, a graceful addition to the community, and a desirable boost to local farm income."
>
> (U.S. Department of Energy, 1995)

The use of straw bales for building construction in Nebraska was most widespread from about 1915 to 1930, and appears to have ended by the 1940s (Myhrman and MacDonald, 1999). Building homes with straw bales has been undergoing a quiet resurgence since the 1970s throughout North America, including across Canada.

It is estimated that in the spring of 2000 there were close to 1,000 new straw houses in Canada (Freedman, 2000). There are private straw bale residences in almost every province across the country. Some of these homes are in urban centres such as Toronto and Montreal, with others in rural communities such as Hockley Valley (Ontario), Steinbach (Manitoba), and Coronation (Alberta). One better known example in a First Nation community is the Kanata 2000 straw bale demonstration home in the Mohawk First Nation of Kahnawake, in Quebec.

5.4.1.3. Straw Bale Building in Native American Communities

There is a recent history of straw bale building activity on Native American reservations in the United States. One example from the early 1990's is a combination "straw bale walls and adobe walls" home on the Navajo Nation, the largest Native American reservation in the United States (located in parts of Arizona, New Mexico and Utah). The home, built in 1993 near Ganado, Arizona,

was documented by the U.S. Department of Energy in *House of Straw: Straw Bale Construction Comes of Age* (1995).

Since 1998, the construction of straw bale homes in Aboriginal communities within North America has been most active in southern Montana. In this mid-western U.S. State, various individuals and groups in two communities, the Crow Reservation and the Northern Cheyenne Reservation, have built five straw bale structures – homes and community buildings – in total. The activity in these two communities is the result of the support of Red Feather Development Group, the University of Washington, and Pennsylvania State University.

5.4.1.4. American Indian Sustainable Housing Initiative

In 1998, Red Feather Development Group (see section 5.4.1.4) and the University of Washington's College of Architecture and Urban Planning, led by faculty member David R. Riley, partnered to form the American Indian Sustainable Housing Initiative (AISHI). The AISHI was formed to explore the application of straw bale construction on U.S. Northern Plains Native American reservations. Red Feather provided financial support, through its donors, and an army of volunteer builders. The University brought research, design, and construction planning expertise and provided a mechanism for its students to be involved in the design and construction process.

The program was designed to engage community members and other non-profit organizations in the construction of straw bale homes and community buildings. One of the objectives at the outset of the AISHI was to develop a model straw bale home design. Three goals guided the design, and subsequent refinements and improvements to the design:

1. Demonstrate the viability of load-bearing straw bale building methods as a regionally appropriate sustainable housing solution.
2. Maximize the inclusion of locally available sustainable building materials and the use of semi-skilled labour (trained on-site) through teachable design details and building methods.
3. Minimize expensive building materials, technical construction steps, and the connectivity between community-built elements and parts of the building that need to be completed by contractors.

Under the AISHI, three prototype homes were built on the Crow (Montana), Lakota (South Dakota), and Northern Cheyenne (Montana) reservations to experiment with load bearing straw bale wall systems and a whole-house design concept, both sensitive to the values of community members and appropriate to the harsh climate of the Northern Plains (Riley 2003).

Students from the University of Washington were involved in the design and redesign of the model straw bale home and participated in the construction of the prototype homes through summer “blitz builds”.

Prototype 1 (1999)

The first prototype home, built in May 1999 on the Crow Reservation in Montana, is a one-and-a-half story, three-bedroom home. This project was the first of its kind in the northwest United States, and the first time the University team and Red Feather assessed the materials available in the region. They quickly determined that only smaller two-string bales were readily available. But, two-string bales are not well suited to load bearing straw bale structures; structures in which the straw bale walls carry the load of the roof. This issue was overcome by modifying the design of the home to allow for a two-bale thick (2-wythe) exterior wall.

The University of Washington students created construction drawings for the home and developed a construction schedule for a two-week “blitz build”. Actual construction time for the completion of the home was 27 days, using 15% semi-skilled labour and 85% skilled labour (see Appendix 9). Upon returning to the University, the students assessed the design and construction process and, based upon their evaluation, produced new plans for a model home.

Prototype 2 (2000)

The second prototype home, built in July 2000 on the Lakota Reservation in South Dakota, is a single story, two-bedroom home. This home utilized the newer home plans (see Appendix 10), which placed the utilities (primarily water and wastewater lines for the kitchen, bathroom and laundry) in the centre of the home surrounded by the straw bale shell (see Figure 5-2). Students and University faculty also developed more detailed construction drawings, illustrative hand-out materials, and a new construction schedule. The goal was to achieve a 14-day completion time.

Built by Red Feather volunteers, University of Washington faculty and students, St. Thomas More parishioners, Oglala tribal members and members of the Adopt-A-Grandparent Program, the additional planning did result in the home being completed in 14 days. The home was built with 35% semi-skilled labour and 65% skilled labour, thus demonstrating that the design and planning improvements made the home easier to build and less expensive. The funds to construct the home were donated by St. Thomas More of Darien.

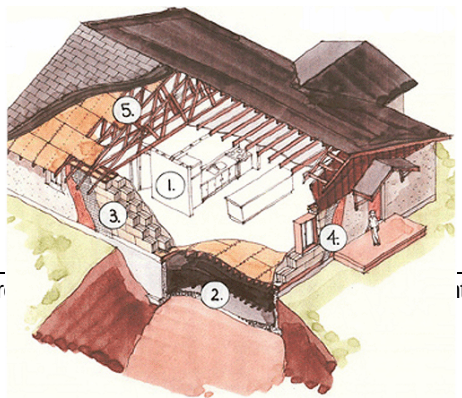


Figure 5-2. Model Straw Bale House Design

1 – The core of the residence contains most of the technical portions of the residence, including plumbing and electrical.
2 – There is a 48”craw space under the house.

3 – The bales bear the weight of the roof directly, which eliminates most wood framing.
4 – The window opening and door bucks are made of 2x4s and 1/2'" plywood.
5 – The roof is constructed with conventional wood trusses and covered with metal roofing.

Source: www.engr.psu.edu/greenbuild/model_straw_home.html

Prototype 3 (2001)

The third prototype home, built in July 2001 on the Northern Cheyenne Reservation in Montana, is a single story, four-bedroom, two-bathroom home, the largest to date. This is the Bear Quiver Family Residence, one of the four straw bale structures visited for the purposes of this study, and the first of five case studies described below in Section 5.4.2.

The design and floor plan for this home was based on the Lakota home (prototype 2). Modifications were made to the prototype design to suit the home to the needs and preferences of the Bear Quiver Family, primarily two additional bedrooms and a second bathroom. The homeowner, University of Washington students and Red Feather volunteers completed construction of the home in 21 days (38% semi-skilled labour and 62% skilled labour). As a result of the extensive use of wood-framed interior walls (necessitated by the additional rooms), researchers are investigating the use of a prefabricated modular core for the next prototype home.

At the conclusion of the construction of the three prototype homes, the partners to the AISHI evaluated their success at engaging members of the community. For all three projects there was little involvement of members of the community-at-large. "It became clear, however, that to truly engage tribes in the process, the construction of a single family home, for a single family, does not adequately make a connection with the tribe as a community." (Riley 2003).

The partners determined that a more effective means of engaging the community in straw bale building projects might be to construct community buildings that would benefit the community as a whole. It was also recognized that it would be beneficial to allow more time for volunteers from outside the community to visit with community members.

To address this challenge, in the summer of 2002, the AISHI partners divided into two teams to concentrate on two community projects – one on the Northern Cheyenne Reservation, the other on the neighbouring Crow Reservation. The Northern Cheyenne project, a Literacy Centre, was led by Pennsylvania State University and the University of Washington (in 2001 David R. Riley moved from the University of Washington to Pennsylvania State University, and has continued his work on straw bale building in Native American communities at Penn State) in conjunction with the community-based Chief Dull Knife College. Red Feather worked with a group on the Crow Reservation to construct a straw

bale Study Hall project for the community. Both projects are documented in section 5.4.2.

5.4.1.5. Red Feather Development Group

Red Feather Development Group is an independent non-profit, charitable organization that is helping Native American communities develop feasible, long-term housing and community development solutions. Originally based in Belleville, Washington, Red Feather moved to Bozeman, Montana in May 2003 to be closer to the Crow and Northern Cheyenne Nations. The organization was founded in 1995 by Robert Young in response to the housing conditions Mr. Young observed during a visit to an Native American reservation; housing conditions not unlike those experienced by many First Nations in Canada.

Red Feather's primary activity is to help Native American individuals and communities design and build straw bale homes and community structures. Red Feather has chosen to build with straw bales for the following reasons (Red Feather, 2003):

- Straw bale is environmentally sustainable; its basic building blocks are human labour and wheat straw, a waste material;
- Straw bale has been used as a construction technique since the early 1800's and is now a commonly accepted method of building;
- Straw bale construction is user-friendly, Native American families and neighbours can easily join in the building process;
- Many educational resources exist on straw bale construction methods, and most states have implemented straw bale building codes;
- Wheat straw is a plentiful resource on Native American reservations, with thousands of acres of land currently in production but few markets for the commodity; and
- Structures built with straw also have an extremely high insulation value, which, when coupled with lower energy consumption, creates a stronger economic base for occupants.

Red Feather has built partnerships with tribal members and other organizations (i.e., universities). The organization is sensitive to the cultural needs of communities and includes community capacity building and personal enrichment in all of its projects.

Red Feather staff and volunteers conduct straw bale construction seminars and hands-on clinics throughout the fall and winter months to train and prepare tribal members on all aspects of straw bale construction methods, home maintenance, mortgage opportunities and community planning ideas.

For a two-week period during the summer Red Feather staff and volunteers work with a homeowner or community members to build the straw bale structure. The

volunteers (who can apply on Red Feather's web site) come from across the United States and are required to pay their own travel, accommodation and meal expenses. This significant volunteer component of Red Feather's work supplies the homeowner or community with free labour and "gives volunteers from all over the country the opportunity to come face-to-face with American Indian cultures and the opportunity to become part of productive solutions to the many housing and community development problems affecting their communities." (Red Feather, 2003)

In addition to volunteers, Red Feather relies on the financial support of individuals, foundations and private corporations. The organization's fundraising effort is called the American Indian Sustainable Housing Initiative.

Red Feather is currently working with the Crow Nation to develop the first straw bale housing, planned community on a Native American reservation. The organization has also been asked to assist the Turtle Mountain Community College (TMCC) in North Dakota with the design and construction of a straw bale research facility for the college. Construction of the research facility is scheduled to occur in July 2003. TMCC students and Chippewa tribal members will provide the bulk of the volunteers for this project, but Red Feather will also bring its own volunteers to assist the community.

Red Feather Development Group communicates information about its work through a seasonal newsletter and its web site at www.redfeather.org.

5.4.1.6. Pennsylvania State University

Pennsylvania State University's Department of Architectural Engineering became involved in Native American straw bale housing in 2001 when David R. Riley moved to Penn State from the University of Washington – where, along with Red Feather, he helped to initiate the American Indian Sustainable Housing Initiative (AISHI) (see section 5.4.1.3).

One of the challenges experienced with the AISHI was to engage the community members in the projects and develop a long-term relationship with the tribe. With the early prototypes, volunteers put a great deal of time into planning and spent a short amount of time in the community to build the home. There was no structured mechanism for follow-up with the tribes. To address these issues and provide a long-term learning opportunity for students who will become the next generation of engineers and architects, Pennsylvania State University's Department of Architectural Engineering has developed an applied course.

"With the support from the Penn State Bowers Program for Excellence in the Design and Construction of the Built Environment, the American Indian Housing Initiative projects were incorporated into a formal three-part course at Penn State, exploring how sustainable building methods, including sustainable construction,

can be utilized to improve the impoverished living conditions endemic to tribal reservations." (Riley and Workman, 2003) The course is offered to students in Engineering, Architecture and Landscape Architecture.

Part one of the course, which is offered in spring, is a study of sustainable building technologies (including straw bale construction). This course also includes a lecture series on Native American culture, history and socio-politics. Part two of the course (Summer) involves Penn State students partnering with University of Washington students/faculty and tribal members to design a straw bale structure. This part of the course also includes a two-week "blitz-build" on location with the university and tribal partners to construct the building. Part three of the course (Fall) provides the university students and faculty with an opportunity to assess the experience and make recommendations to improve the course.

The first iteration of this course was centred on the design and construction of the Northern Cheyenne Literacy Centre at Chief Dull Knife College on the Northern Cheyenne Reservation in Montana (the subject of the case study in section 5.4.2.4). Although this building project was a success (see case study) and the course fulfilled its established objectives, there was still a question of the long-term sustainability of the course offering and partnership with a tribal entity.

To ensure the long-term sustainability and success of working with a tribe and continuation of the Penn State course, the University has now formally partnered with Chief Dull Knife College. The partners and the role of each partner is as follows:

- Chief Dull Knife College – provides an educational base on-site, facilitating the participation of tribal students and community members in projects.
- Pennsylvania State University – provides technical background on the effective and integrative utilization of straw bales in the design and construction process.
- University of Washington – contributes expertise and consultation on sustainable community development.

With a formal partnership established with a tribal entity, the university partners now know the educational component can be sustained long-term. Knowing this, course work for the three-phase course at Penn State outlined above can and will focus on the needs and problems specific to and identified by the Northern Cheyenne community. For the community, the establishment of the partnership and the long-term sustainability of the program has resulted in the Tribal Housing Authority and Chief Dull Knife College partnering to develop an apprenticeship

> "You can't learn what I learned in Montana in a classroom. It was wonderful – not only working with the Cheyenne but getting to know other people from across the country who are interested in this cause."
>
> – Carla Palavecino (student)

program for tribal members. Through the apprenticeship program tribal members will work side-by-side with university students and faculty to learn how to build straw bale homes. The apprentices will be able to apply their knowledge, teach other community members and, over time, work towards a model of community-built sustainable housing (Riley and Workman, 2003).

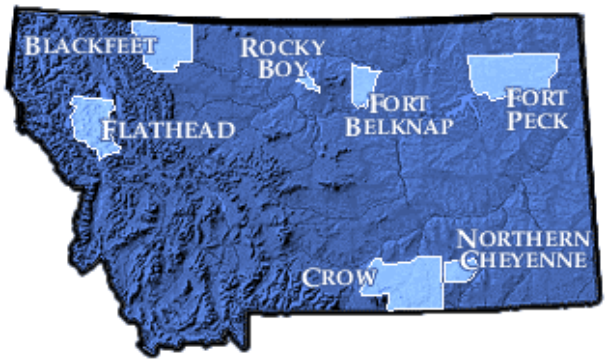
Concluding this overview, it is evident that early success with straw bale construction in Native American communities is the result of access to external experts and volunteer homebuilders. As building with straw bales proves a viable building technique on the Crow and Northern Cheyenne Reservations in Montana, Red Feather Development Group, Pennsylvania State University and the University of Washington are formalizing their partnerships with these two communities. Although these partnerships provide long-term sustainability to the programs, the partnerships will only last as long as is necessary for the initiative to take root in the communities and become managed by the tribes themselves.

5.4.2. Case Studies

There are five straw bale case studies documented in this report. The first four of these case studies are buildings in Montana that were visited by a member of the CIER research team. These are the Bear Quiver Family Residence, the Northern Cheyenne Literacy Centre and the Muddy Hall Community Centre on the Northern Cheyenne Reservation, and the Crow Study Hall on the neighbouring Crow Reservation. The fifth case study is the Kanata 2000 demonstration home in the Mohawk First Nation of Kahnawake in Quebec. Information about this project was gathered from literature and during telephone conversations with Kahnawake community members.

5.4.2.1. Bear Quiver Family Residence

The Bear Quiver family residence, constructed in 2001, is located on the Northern Cheyenne reservation near Busby, Montana. Martha Bear Quiver, her husband Curtis and their four teen-aged children were living in a small HUD (U.S. Department of Housing and Urban Development) home rental unit when Martha was inspired by a straw bale home built in 1999 on the neighbouring Crow reservation. Ms. Bear Quiver secured a U.S. Department of Agriculture rural development mortgage to build the home. Assistance with the design and construction of the home was provided by Red Feather Development Group and the University of Washington.



Community Profile

The Northern Cheyenne Reservation is located in southeast Montana and is bounded on the east by the Tongue River and on the west by the Crow Reservation. Approximately 5,000 Northern Cheyenne members, along with members of other tribes, live on the reservation. The total tribal enrolment is 6,479. The total labour force of the reservation is 1,218 and the unemployment rate is 31.4%. The annual per capita income is $4,479.
The rugged country of the Northern Cheyenne Reservation covers 180,000 hectares (445,000 acres). The topography of the reservation is made up of valleys and plateaus, rivers, streams and prairies. Elevations range from 915m (3,000f) to 1,500m (4,900f) above sea level. Much of the higher elevations are covered by Ponderosa Pine timber. The area is suitable for farming and ranching, both of which are important to the economy of the Tribe. The reservation has an average temperature of 8^{o}C (46^{o}F). The highest temperature recorded was 43^{o}C (109^{o}F) and the lowest was -30^{o}C (-22^{o}F). Although Montana has a relatively dry climate, the snow is sometimes heavy and damp.

Using Local Materials: The Decision-Making Process

An existing straw bale home on the neighbouring Crow Reservation inspired Martha Bear Quiver to build with straw bales. The Crow Reservation house is a one-and-a-half story, three-bedroom home constructed in May 1999 (see section 5.4.1.3).

Martha Bear Quiver visited the Crow Reservation home after reading about it in the Billings Gazette. She liked that the home feels airy yet cozy, that it has a

"natural" feeling, and that it has lots of windows. She also learned that the house remained cool in the summer, even when the outdoor temperature was hot. At the time Martha had not done much research into straw bale homes, but she was aware that Red Feather had helped to build the Crow reservation home.

The land for the home was given to Martha by her brother; it is not tribally owned. She secured a mortgage from the United States Department of Agriculture's Rural Development branch to construct the home. Ms. Bear Quiver was the first person in her community to secure a mortgage from an entity outside of the reservation.

The Local Material

As described in section 5.4.1.2, only two string straw bales are currently available in Montana. Two string bales are roughly 18"x14"x36" and weigh roughly 50 to 60 pounds. Three-string straw bales, on the other hand, are typically 24"x17"x46" and weigh approximately 90 pounds (Cook, 2004). Three-string bales are structurally stronger, have higher R-value and are often more compact (U.S. Department of Energy, 1995).

Thus, although straw was available in Montana in sufficient quantity and amounts to build the Bear Quiver home, the fact that it is not baled with three strings meant that bales for the Bear Quiver home had to be obtained from elsewhere. Red Feather obtained the straw bales for this project from a farmer near the town of Ellensburg in Washington State, immediately west of Montana (Young, 2004).

About 300 bales were purchased for the construction of the home, which is a 150 m^2 (1,600 ft^2) single story structure. With each bale weighing approximately 90 pounds, this equates to approximately 12 tonnes of straw. Since the straw is baled in the fall at harvest time and the home was built in July, the bales used to construct the home in 2001 were made in late 2000. The Washington farmer stored the bales over the winter months and shipped them via semi-trailer truck to the building site in early July – shortly after the foundation was finished and three to four days before the start of construction.

The straw bales did not require any special preparation prior to construction. Some of the bales were cut during construction to fit irregular wall lengths created by the placement of window frames and doorframes. They bales must remain dry during construction and in this instance they were covered with a tarp when delivered and during construction. Fortunately, rain was not a concern during construction.

Not all of the 300 bales were used for the home. The homeowner planned to use the extra bails to build a garage, however the trap covering the extra bales has since become unsecured and the bales are perhaps no longer suitable for building.

Design/Construction with the Local Material

The Bear Quiver family residence is a single story 150 m^2 (1,600 ft^2) four bedroom home. It features two bathrooms, a living room, a dining area, a kitchen, a laundry area and an airlock vestibule at the front entrance.

The straw bale home is a load-bearing structure; the exterior straw bale walls carry the load of the roof. The roof is covered with standard metal roofing, the same as that which is becoming popular for residential application. The interior partition walls are conventional 2x4 construction finished with a product called DuraRock and a thin layer of the stucco used to coat the bales (see below).

The design of the Bear Quiver home is based upon a prototype design previously completed by University of Washington students (see Appendix 10). This prototype design (a two bedroom, one bathroom home) adheres to the concept of a minimalist utility core surrounded by the straw bale shell. Modifications were made to the prototype design to suit the home to the needs and preferences of the Bear Quiver Family – two additional bedrooms, a second bathroom and relocation of the living room from the south side of the home to the north, in order to capture mountain views.

The design modification was an iterative process that was led by the homeowner. Working with Red Feather and a designer hired by Red Feather (a University of Washington graduate who participated in the construction of the first prototype home on the Crow Reservation), Martha Bear Quiver was provided the opportunity and support to modify the house design until she was satisfied with the layout of her family's new home. The design process, which went through three iterations, began in November 2000 and was completed in May 2001. During that time David R. Riley from Pennsylvania State University provided engineering expertise to the process.

This was the first time a homeowner in the community was provided the opportunity to participate in the design of their home. Due to the geographic distance between the homeowner and the team working on the design modifications, no face-to-face meetings occurred during the design phase. Each iteration of the design was faxed to Ms. Bear Quiver at her place of work. Ms. Bear Quiver provided feedback to the design team during conference calls with the entire team or through the staff at Red Feather.

The design of the residence was required to meet the standards of U.S. Department of Agriculture's Rural Development branch. An inspector from Rural Development, Office of Buildings visited the site during construction to ensure that construction proceeded in accordance with the approved design and that building standards were being maintained.

Construction of the Bear Quiver family residence started in mid June 2001 and was completed during the last week of July 2001.

Individuals from the Northern Cheyenne Housing Authority arrived at the building site on or about June 14, 2001 to pour the foundation and construct the decking. Other than preparing this base and establishing the water and wastewater infrastructure (which was undertaken by Indian Health Services and paid for by the Tribal Council), the house was built by Martha Bear Quiver and a team of volunteers from outside the community.

A building crew of faculty and students from the University of Washington and Red Feather volunteers arrived at the site on July 4, 2001. Many of the students and Red Feather volunteers were familiar with straw bale building from having participated in the construction of the earlier straw bale home prototypes (see section 5.4.1.3).

The straw bales arrived a few days after the volunteers and construction of the exterior straw bale walls began on July 8, 2001. The construction was managed by a Red Feather volunteer, who also happened to be an electrician. Because building with straw bales is a “low-tech” construction method, Ms. Bear Quiver (and new volunteers) learned straw bale construction by simply observing the experienced students and volunteers. This allowed her to easily to participate in the construction of the bale walls.

Members of the community did not participate in the construction of the home, although some did drop by periodically to observe the construction. Ms. Bear Quiver indicated that perhaps some members of the community were not comfortable with the large group of non-Aboriginal volunteers and visitors who came to build the home. Ms. Bear Quiver attributes her comfort level with the non-Aboriginal volunteers to having had non-Aboriginal friends since childhood and having attended Washington State University.

The exterior straw bale walls of the house went up in two or three days. The bale walls (both sides – interior and exterior) are then covered with chicken wire mesh stucco. Application of the stucco took three days for the exterior side of the bales and three days for the interior side; six days in total. The bales walls require three layers of stucco – one layer per day. The roof was erected in two days and the remainder of the construction time was allocated to finishing the interior.

Once the two-week “blitz build” ended for the students; the Red Feather volunteers remained on-site for an additional week to complete the construction of the home. This involved completing the interior, including the installation of the plumbing and electrical and all finishing materials. The house construction required about 5 to7 days longer to build because of the extra wood-frame construction inside the home – the result of the additional rooms added to the prototype floor plan.

Outcome

Martha Bear Quiver is very pleased with her family residence, due in large part to her ability to drive the design of the home to suit the needs and preferences of her family. She is also pleased, and proud, because building with straw bales allowed her to easily participate in the construction of the home. According to Ms. Bear Quiver, the home has a peaceful feeling she has not experienced in other homes. She postulates that this is because straw bale homes have thicker walls and therefore feel more solid and secure. She also noted that the house is warm in the winter and remains cool during the summer, without air conditioning.

The total cost of the home (including appliances) was $63,000.00 (all amounts in this section in U.S. dollars), not including the land, construction labour (provided free by the volunteers) and the cost of transporting the straw bales.

By comparison, the Bear Quiver family also considered a modular wood-frame HUD (Housing and Urban Development) house – the typical home in her community. All of the models they liked were priced in the $81,000+ range, an amount greater than their budget. The only modular home they could afford was a 113 m^2 home priced at $70,650.00 (37 m^2 smaller in size and $7,650.00 greater price than the straw bale home). The family also looked into the cost of a site-built wood-frame home. A 65 m^2 home – half the size of the straw bale home – would have cost $70,000.00.

Advice to First Nations:

"If they are willing to commit volunteer labour to help each other, it [building homes with straw bales] is better".

– Martha Bear Quiver

In addition to the reduced expense to build the straw bale home, the Bear Quiver home is also less expensive to heat than a similar sized wood-frame home in the community. The family's heating bill, which includes the cost of fuel (propane) used for the water heater, the kitchen stove and the clothes dryer, was $600.00 for the 2002 calendar year. Comparatively, the 2002 heating bill (for space heating only) for a similar sized wood-fame home in the community was $1,800.00. Since the heating bill for the Bear Quiver's straw bale home also includes the cost of fuel for three appliances, the cost of heating the wood-frame home is more than three times the cost of heating the straw bale home.
As a result of the Bear Quiver straw bale home, other members of the community are now interested in building a straw bale home – including Ms. Bear Quiver's sister.

The following advantages and disadvantages were identified as a result of this case study:

Advantages:

- One of the primary advantages is that the homeowner had an experienced volunteer resource to turn to, to assist with the design and construction of the home.
- The "low-tech" method of load-bearing straw bale building allows an unskilled homeowner or volunteer to participate in the construction process. For the homeowner this builds pride and a sense of accomplishment.
- The homeowner was provided the opportunity and the support to participate in the design and the home. Personalizing the home fostered a sense of ownership.
- Building with straw bales was less expensive than other materials considered by the homeowner. This may not have been the case without the volunteer labour, however, building with straw bales allows for a large volunteer labour contingent.
- The home is less expensive to heat than a similar sized wood-frame home in the community. This not only saves the homeowner money, it reduced the environmentally degrading greenhouse gas emissions associated with most home heating options.

Disadvantages:

- One of the disadvantages of utilizing volunteer labour from outside the community is that it many discourage community members from participating – a lost learning opportunity.
- The greater the wood-frame partitions inside the home the greater the amount of lumber required fro the home, perhaps detracting from the environmental benefits of straw bale.
- Since the bales could not be sourced in immediate or close proximity to the building site, additional greenhouse gas emissions were generated to transport the bales.
- If the bales are not stored properly, to ensure they do not get wet, they are rendered not suitable for building.

5.4.2.2. Northern Cheyenne Literacy Centre (Chief Dull Knife College)

The Northern Cheyenne Literacy Centre on the campus of Chief Dull Knife College in Lame Deer Montana was built in July 2002. The centre was designed to serve as a new home for the College's Graduate Equivalency Diploma and adult basic education programs.

This project was the first time the university partners, University of Pennsylvania and the University of Washington, developed a formal partnership with a tribal entity. David R. Riley, Associate Professor of Architectural Engineering at Penn State University, led the project in collaboration with the School of Architecture

and Landscape Architecture, University of Washington and Chief Dull Knife College.

The interior of the Literacy Centre was being finished during the site visit. Stucco had been applied to the interior side of the straw bales walls, and the partition walls and interior ceiling were complete. Workers from the community were painting the partition walls and installing fixtures in January 2003.

Community Profile

See section 5.4.2.1.

Using Local Materials: The Decision Making Process

The building had been originally conceived as a straw bale children's library. Mid way through planning, for a reason not made clear to the researcher, the target use for the building was changed to the concept of an adult literacy centre.

This project was initiated in part because the external partners (the universities and Red Feather) recognized that during the construction of the first three prototype structures (individual homes), community members were not involved in the building process. The external partners decided that perhaps a better way to engage community members is to build community buildings. In this case, the universities partnered with Chief Dull Knife College to build the Literacy Centre.

Funding for the building was provided by a United States Department of Agriculture (USDA) Tribal College Grant and the Red Feather Development Group.

The Local Material

Approximately 225 three-string straw bales were used to construct the exterior walls of the building. The bales were purchased from the same Washington State farmer who Red Feather had obtained the bales from for the Bear Quiver Family Residence. The farmer harvests the straw in the fall and stores the bales over winter so they are ready to ship in time for building the following summer.

Out of state bales were used because only two-sting bales are available locally; no local farmer has a three-string bailer. Efforts are being made to convince the community to buy a 3-string bailer.

Straw bales were not modified for construction. As required, bales were cut to fit specific locations; smaller spaces created on either side of windows and doors. A tarp was used to keep the bales dry before and during construction.

Design/Construction with the Local Material

The Literacy Centre is a 140 m^2 (1,500 ft^2) load-bearing building with a concrete foundation and crawl space, and a metal roof. The layout of the interior of the building features an office, testing/tutoring rooms, a meeting room and children's reading area (see Appendix 11). The interior design elements include a vaulted ceiling and round interior walls.

Pennsylvania State University faculty and students designed the Literacy Centre building, with input from University of Washington students. To facilitate the students from different geographical locations working together, Penn State arranged a videoconference with the University of Washington in April 2002. The videoconference allowed the students to more easily collaborate on the project.

The building plans had to be submitted to the Rural Development branch of the U.S. Department of Agriculture for review and approval by the agency's engineers.

The Literacy Centre was built with the help of 27 Pennsylvania State University and 28 University of Washington Students – 55 students in all. The two-week "building blitz" started when students arrived on July 14, 2002, and ended when they left on July 31. The foundation was poured but was not cured when the students arrived. Thus, unlike the Bear Quiver home, the students were not able to start building the straw bales walls immediately upon their arrival. Waiting for the foundation perhaps contributed to the building not being closer to completion by the time the students two week visit to the community was over.

Professors from Penn State and Washington State universities managed the construction of the Literacy Centre and provided a daily orientation and instruction to straw bale building. Local Northern Cheyenne residents participated by providing the artwork for the building – in the form of tile mosaics and trim paintings.

At the time of the visit the interior of the building was just nearing completion. Thus it was not possible to obtain any information on the performance of the building during its use.

Outcome

The project was such a success that the universities and Chief Dull Knife College have since partnered to develop a straw bale building program for the community. The universities provide research and expertise in straw bale building, and a pool of students for summer "blitz builds", and the community will launch an

> "The community liked having the students around and had a big BBQ for them. The students were interesting, helpful and asked questions. They were also respectful and wanted to learn more about the community."
>
> – Joan Hantz, Library Director

apprenticeship training program to teach community members how to build with straw bales.

As indicated above, one of the objectives of the project was to better involve members of the community. During this project, research teams of faculty and students visited community organizations and community members in an effort to assess the values and concerns of the tribe with respect to housing conditions and their communities. Evening presentations from the tribe helped to educate the visitors about the community and the history of the people. These meetings also provided the groups with the opportunity to meet informally.

Individuals interviewed indicated that the students were well received in the community. The community had a BBQ and Pow Wow for students. Thus, the students not only received hands-on learning from the project but also a chance to learn about the local area and the people who they were working for.

The following advantages and disadvantages were identified from this case study:

Advantages:

- It was important for the external organizations (the universities) to partner with a tribal entity (Chief Dull Knife College). This likely contributed to the communities acceptance of the of the university faculty and students.
- It was important that the university faculty members were there to oversee the project.
- Although this building was not yet entirely complete during the site visit, the construction was identical to the Bear Quiver Residence and thus it is assumed that building will have the same warmth retaining and heating efficiency properties in the winter.
- The construction of this building inspired a member of the Northern Cheyenne Tribal Council to use straw bale for the Muddy Hall Community Centre (see section 5.4.2.3)

Disadvantages:

- Because the foundation was not ready when the volunteer building crew arrives, the lost days perhaps contributed to the building not being nearer completion before the students left the community.
- As with the previous case study, the bales were sourced from out of state, due to the fact that the preferred three-sting bales are not yet produced in Montana. The community is considering purchasing a three-string baler.

5.4.2.3. Muddy Hall Community Centre

The Muddy Hall Community Centre on the Northern Cheyenne reservation is a straw bale addition to an existing wood-frame un-insulated steel-clad building. This straw bale project, undertaken in the summer of 2002, was the sole initiative of the community. Limited support was provided by Pennsylvania State University.

Community Profile

See section 5.4.2.1.

Using Local Materials: The Decision Making Process

Community member Otto Braided Hair initiated the community centre project. Impressed by the straw bale construction of the Literacy Centre (see section 5.4.2.2), Mr. Braided Hair recognised that using straw bales for this project would provided a good opportunity to test the use of straw bales on a project initiated by the community. Mr. Braided Hair is a member of the board at Chief Dull Knife College.

Prior to the decision to build with straw bales, Mr. Braided Hair had already succeeded in obtaining a grant from the U.S. Department of Agriculture to build an addition to the Community Centre. Choosing to build with straw bales helped the budget for the project, since straw bales are less expensive than conventional construction and semi-skilled or non-skilled labour can be used to construct the straw bale walls.

The Local Material

Approximately 220 three-string straw bales were used for this project. Like the two preceding case studies, the straw bales were obtained from a farmer in nearby Washington State. The bales were stored by the farmer over the winter and shipped at the same time as the bales for the Literacy Centre.

Also like the two preceding case studies, the straw bales required no special preparation. They were modified if necessary to fit into irregular portions of the wall, created by window frames or doorframes. The straw bales were stored in the pre-existing wood-frame steel-clad portion of the community centre prior to construction.

Design/Construction with the Local Material

The structure is an addition to an existing un-insulated steel-clad building. The Muddy Hall Community Centre is used for community events such as weddings, funerals and voting.

The straw bale addition is designed to house offices for tribal council representatives, a kitchen, washrooms, sauna, a therapy room and large meeting room.

David R. Riley at the University of Pennsylvania prepared the blueprints for the straw bale addition. The blueprints were modified under the direction of a Tribal Council member, in order to provide for a different configuration of the rooms. The Councillor for the district in which the community hall resides will be moving into the straw bale portion of the building. This contributed to the Council's interest in the building's design.

Plans for the addition to the community hall had to be approved by the United States Department of Agriculture's Rural Development branch.

Otto Braided Hair, Tribal Council member and board member of Chief Dull Knife College, prepared the foundation for the building, a slab on grade. Six students from the Literacy Centre project then began working at the Muddy Hall, and as the exterior walls at the Literacy Centre neared completion other students joined the Muddy Hall project.

At the time of the site visit, the building was in the process of being finished by three members of the community who had been hired to complete the job. These individuals were applying the coats of stucco to the interior side of the straw bales walls and erecting the wood-frame partition walls. The interior partition walls were framed using wooden 2x4s, covered with a product called DuraRock (similar to drywall but much stronger). The DuraRock was then to be covered with a thin coat of the stucco used on the straw bales.

Outcome

Since this project was solely an initiative of the community, one of the objectives was to provide an opportunity for members of the community to learn straw bale construction techniques. A member of the community who picked up the basics of straw bale building during the literacy centre project was supervising the three community members that had been hired to complete the community centre addition.

There are a few people in the community who want a straw bale home, and still more that would like to see straw bale construction as a viable enterprise. Thus,

there are latent opportunities to build houses in the community and if people can obtain financing to build houses they will need experienced help.

Also, during the construction of the straw bales walls for the community centre addition, high school students from the community came out to learn about straw bale building. Straw bale building has now become part of the high school curriculum.

The following advantages and disadvantages were identified as a result of this case study:

Advantages:

- Training opportunities are open to almost anyone in the community due to the ease of building with straw bales. Three individuals from the community have been hired to complete the community centre addition. These individuals are being taught by a community member that participated in the Literacy Centre building. Their new skills will be in demand as interest in straw bale building grows in the community.
- The funding for the community hall addition came from the same agency that provided loan for the Bear Quiver Family residence. The funding agency was already familiar with straw bale construction, which helped to speed up the approval process for the community centre.
- A group of community high school students were introduced to straw bale building, and straw bale building has been incorporated into the high school curriculum.

Disadvantages:

- The community has not taken advantage of this training opportunity en masse because the normal construction practice is that the contractor is the builder. The community member being interviewed indicated the thinking that “someone else does it” appears to be an obstacle.
- The community member being interviewed also indicated that in general the community does not appear to appreciate the importance of volunteerism as an important component of straw bale building and other similar projects.

5.4.2.4. Crow Reservation Study Hall

The Crow Community Study Hall on the Crow Reservation in Montana was built in July 2002. The Study hall was designed to serve as a community building; to demonstrate to the community the benefits of building with straw bales. The project was initiated by four Crow grade eight schoolgirls, the “Rez Protectors”, who won an award for straw bale building research and put the winnings toward the construction of the building.

The building will function as a community study hall. It is owned by the community, leased to the St. Labre Indian School, and will be cared for by Little Big Horn College, a tribal community college. The building was officially opened on February 4, 2003.

Community Profile

The Crow Reservation is located in south-central Montana and is home to the Crow people (see Figure 5-2). The reservation is bordered on the south by the state of Wyoming with its northwest boundary about 16 km from the City of Billings, the largest metropolitan area in the state. The eastern boundary of the Crow Reservation is adjacent to the Northern Cheyenne Reservation. The Crow Reservation is approximately 95 km (60 mi) wide and 65 km (40 mi) in length, encompassing 637,136 hectares. About 75% of the Crow Tribe's approximately 10,000 or more enrolled members live on or near the reservation. Some 85% speak Crow as their first language.

Mountains, uplands and alluvial bottoms make up the topography of the Crow Reservation. Rolling upland plains slope downward to the north from the mountains. The plains occupy most of the reservation and vary in altitude from 915m (3,000f) to 1,370m (4,495f) above seal level.

South-central Montana has a moderate climate considering its latitude. Snow seldom accumulates for extended periods because of the warm Chinook winds which blow from the mountains to the east. The area enjoys "Indian Summers" – times of warm sunny days and cool evenings which can extend into November. The mean annual temperature is 7.5^{o}C (45.5^{o}F) with a summer high of 43^{o}C (109^{o}F) and a winter low of -44^{o}C (-47^{o}F). The reservation receives from 30cm (12in) to 45cm (18in) of total annual precipitation, depending on the elevation.

Using Local Materials: The Decision Making Process

The Crow Community Study Hall began as research project of four grade eight students at Pretty Eagle Catholic School. The students, all girls – Lucreia Birdinground, Kimberly Deputee, Omney Sees The Ground, and Brenett Stewart – are members of the Crow Tribe. They were encouraged by their teacher, Jack Joyce, to enter the Bayer/National Science Foundation competition for middle schoolers. To enter the competition, students must use science to address a problem in their community.

The students selected a problem prevalent in their community; lack of adequate housing. Their teacher suggested they visit a straw bale home built in the community in 1999 (see section 5.4.1.3). They were impressed with the home but learned that other community members were sceptical about homes built out of straw bales.

To address this scepticism they decided their project would be to conduct a series of tests on a model straw bale wall (see Appendix 12). They did a fireproof test and determined that the test wall was fire proof. They did a heat transfer test and discovered that the wall had thermal resistance. Finally, they did a moisture test to determine wet weather resistance. They concluded that straw bale houses can stand up to the wet weather conditions in their community.

In addition to their findings, the girls' entry included a statement that they would like to build a demonstration straw bale building in the community. A building that members of the community could tour to become familiar with straw bale structures. They indicated that the $25,000.00 prize, along with help from Red Feather Development Group would be enough to make their dream come true.

The girls, who are referred to as the "Rez Protectors", won the $25,000.00 Bayer/National Science Foundation award (see Appendix 13). They received an additional $25,000.00 from Oprah Winfrey and a $20,000.00 donation of tools from a private company, after appearing on the Oprah Winfrey television show to talk about their story. The roof and heating system were also donated.

With $50,000.00, the girls decided that a community study hall would be the best way to demonstrate the advantages of straw bale building to community members and benefit the tribe as a whole. They teamed up with Red Feather, who helped the students with the design for the building and coordinated a crew of Red Feather volunteers to build the structure.

The Local Material

Straw bales were obtained from a farmer in Washington State. Three-string bales were used, since they are tighter, hold their shape better, and have higher R-value. Local straw bales could not be used because only two-string bales are available in Montana. Wheat straw was used for the bales but rice is also acceptable. Red Feather Development arranged for the transport of bales to the site using a semi-trailer.

The straw bales were stored on-site when received and were covered with tarps to keep them dry. Little or no preparation of the bales was required. Some bales were cut or shaped to fit in specific locations during construction.

Design/Construction with the Local Material

The Study Hall is an 84 m^2 (900 f^2) single story building with a concrete foundation and crawl space, and a metal roof. The interior is an open space design with wood-frame walls erected only to enclose a universal access washroom, utility closet and stairway to the crawlspace below. There is an air-lock vestibule at the main entrance to the building.

The structure was designed by a graduate of the University of Washington, an individual who participated in the design and construction of the first demonstration home on the Crow Reservation in 1999. The Crow students had input to the design, including selecting the interior colours and finishes.

Buildings on the Reservation are not required to meet any building codes; however, plumbing, wiring and the roof system were designed to meet off-reserve codes. The Crow Housing Authority inspected sewer and gas services. No special consideration was given to siting the structure in relation to environmental conditions.

Construction of the Study Hall occurred over a two and a half week period in July 2002. The construction team was comprised of a small group of individuals from the community (including the "Rez Protectors") with the help of 35 volunteer builders coordinated by Red Feather. Red Feather oversaw the construction of the building and provided project management services. The project did not attract volunteer support from the community.

The straw bales were used for load-bearing exterior walls, and covered on each side with three coats of stucco. The Interior partition walls were constructed using 2x4" studs and WonderBoard (a cement based sheet material that is normally used as a backing for ceramic tile). The interior walls were also finished with a thin coat of stucco.

Outcome

The Crow Community Study Hall has appeared to be well received by the community. The building was vacant prior to the official opening in February 2003 and it was not vandalized. This may seem trivial, until you consider that most of the buildings in the community, especially those that are empty, have been vandalized.

Advice to First Nations:

"Build one and become involved. The real beauty is that these houses pay for themselves in terms of efficiency to heat."

– Jack Joyce, Teacher

The following advantages and disadvantages were identified as a result of this case study:

Advantages:

- The Crow community has a public straw bale building that community members can visit to become familiar and comfortable with straw bale buildings.
- The award and the recognition has brought a sense of pride to the four schoolgirls, their families and the community.

- Once again, an external organization Red Feather) helped bring the building to life by providing design services and a crew of volunteer builders.

Disadvantages:

- Like all of the case studies before it, the straw bales for this project travelled from outside the state of Montana, generating unnecessary greenhouse gas emissions and other impacts from transportation. Unnecessary, because agricultural crops generate straw as a waste product are grown in Montana. The only missing piece is a three-sting baler.

5.4.2.5. Kanata 2000 Demonstration Home (Kahnawake)

The Kanata 2000 Demonstration home in the Mohawk community of Kahnawake, in Quebec, was not visited by a member of the CIER research team. Instead, information about this case study was gathered from literature and via conversations with members of the community.

Using Local Materials: The Decision Making Process

The Kanata 2000 housing project was established in 1997 after the Kahnawake Environment Office and the Kahnawake Housing Department obtained money for the construction of an innovative house. There was a need to address the environmental and human health problems associated with the current stock of housing in the community.

The Kanata 2000 design team was created with the mission to provide the community with the tools and models to choose a sustainable shelter and lifestyle, and to make the most efficient use of resources. The objective was to build a demonstration home that is: sustainable, affordable, environmentally sound, low maintenance, culturally relevant, educational, adaptable to different needs, reproducible, makes efficient use of space, uses healthy building materials, uses efficient landscaping, creates jobs and builds community.

Funding for the project was provided by Indian and Northern Affairs Canada, Canada Mortgage and Housing Corporation and Natural Resources Canada. In addition, the community has devoted hundreds of in-kind hours to the project.

The Local Material

The straw bales used for this demonstration home were made with native switch grass. The field where the bales were made was approximately 30 km from the site of the home. Approximately 350 bales were purchased at a cost of $2.75 each.

Design/Construction with the Local Material

The design of the Kanata 2000 demonstration home includes the following features:

- Slab on grade
- Straw bale construction
- Passive solar design
- Earth block wall
- Solar domestic hot water
- Electric radiant floor heating with solar back-up
- Healthy materials and finishes
- Water and energy efficient appliances and fixtures

The bales were used to construct an in-fill (non-structural) straw bale wall. This means that the straw bales wall does not carry the weight of the roof; the roof carried by other structural supports and the straw bales are used to fill in and complete the construction of the wall.

Construction of the home was completed in spring 2001 by members of the community.

Outcome

The house is living example/demonstration of how to construct a sustainable house with locally available building materials. The home is very fire resistant (according to National Research Council testing), super insulated (R-50), it is structurally sound and acts as a noise barrier, it is cool in the summer and warm in the winter and simplicity of straw bale construction makes is easy for the homeowner to engage in the construction of the home.

5.4.3. Advantages / Disadvantages of Straw Bale

Previous research (CMHC 1998; CMHC 1997; CMHC 1986) on the use of straw bales for housing construction has illustrated some of the concerns around this building material (e.g. water infiltration). As with all housing construction there are particular details that require technical expertise and attention to detail (e.g. around windows and doors), however, in the case of straw much of the labour can be completed by relatively unskilled participants. In the cases presented in this research, the partnership between the communities and the AISHI provided the expertise required to ensure the straw bale buildings were well constructed.

A summary of the advantages and disadvantages of straw bale construction, as presented by the interviewees and derived via analysis is outlined here:

Advantages:

- Straw is a natural and annually renewable material.
- Straw is abundant; it is available anywhere agricultural grain crops are grown.
- Straw bale building is a relatively low-tech construction method, which allows homeowners and community members with no previous construction experience to participate in the construction process.
- Because unskilled labour can be used to construct significant components of a straw bale home, there are opportunities to reduce labour costs associated with building a home.
- Straw bale walls have a high insulation value: from R-40 to R-50.
- Straw bale homes keep the warmth in during the winter and remain cool inside during the summer.
- Straw bale homes are less expensive to heat than modular or poorly constructed wood-frame homes.

Disadvantages:

- For the case studies visited during this research project, square three-string straw bales were not available locally. This (1) increased the cost of transporting the bales to the building site and (2) resulted in the emission of an uncalculated amount of carbon dioxide and other emissions from the burning of the fossil fuels used to transport the bales from Washington to Montana. Carbon dioxide is a greenhouse gas, and is thought to be one of the primary causes of climate change.
- Must take extra precaution to ensure that bales do net get wet before or during construction.
- Straw bale building is not a widely accepted building practice. This may cause some challenges with building codes

5.4.4. Lessons Learned

- Three-string straw bales are preferable to two- string bales. Two sting bales are roughly 18”x14”x36” and weigh roughly 50 to 60 pounds. Whereas, three-string straw bales are typically 24”x17”x46” and may weigh approximately 90 pounds. Three-string bales are structurally stronger, have higher R-value and are often more compact.
- The most efficient design for a straw bale home is a single story structure with a minimalist utility core surrounded by the straw bale shell. The utilities (primarily water and wastewater lines for the kitchen, bathroom and laundry) are placed in the centre of the floor plan.
- Detailed construction drawings, illustrative hand-out materials, and a tight construction schedule can help if there is limited time to build the home.

- Because straw bale building is not readily accepted and there are important technical detailed involved in achieving the benefits of using straw, it is important to have expertise involved (e.g. partnerships).
- A straw bale house can be closed in 7 days with the right number of builders (10 to 15); 2 days to erect the straw bale walls, 2 days to build the roof and 3 days to apply the stucco on the exterior and interior sides of the straw bales walls.
- If the home is built with a team of volunteers during a two- or three-week "blitz build" it is important to have the foundation poured and the site ready for the volunteers to start building the straw bale walls when they arrive.
- It is good to have some experienced people on hand to demonstrate for the rest of the crew. Also important to have someone at the site experienced with straw bale to manage the process.
- Straw bale provides opportunities that extend beyond the home and homeowner. There are educational/training opportunities and opportunities for non-Aboriginal non-skilled individuals.
- The bales have to be stored and kept dry over the winter if construction is in the spring or summer.

5.4.5. Sustainability of Straw Bale

- Straw is an abundant waste product from the production of agricultural grain crops.
- Plant fibres mature much quicker (about six months) compared to tree fibres (six to ten years). Thus using straw bales to construct houses can be more easily sustained over the long-term by the natural environment than other renewable resources.
- There is a large social sustainability component to building with straw bales. This is because the exterior structure of the home can be built with unskilled labour.
- To maximize the sustainability of straw bale, the agricultural practices used to produce the straw must also be sustainable, and preferably apply organic practices.

> "Because of the abundant supply of straw on the Northern Plains (many reservations have wheat fields leased to farmers) and the volunteer friendly construction process, straw bale construction presents and opportunity for tribal members to help each other build comfortable, durable, energy-efficient housing."
>
> – David R. Riley (2003)

5.5. Analysis: Applicability to Other Regions

This section looks at the applicability of clay, timber for log homes and straw bales for housing in communities in similar geographic regions to those discussed in this research.

In addition to geographic applicability of the materials, the initial scope of the analysis was to include a rudimentary economic feasibility analysis. An economic feasibility analysis was not possible at this time, due to a complete absence of financial information on these housing projects. In the case of clay, Sumas First Nation was not yet building with bricks and therefore did not have costs for building brick homes readily available. The communities building with log homes were able to give only general figures of the construction costs and did not necessarily differentiate between log houses and other houses within annual housing budgets. The owners of the straw bale homes and buildings in Montana did not maintain detailed cost record of their respective structures. The need for an economic analysis is discussed further in Section 6.4, Recommendations for Future Research.

5.5.1. Local Timber/Logs

Many Aboriginal communities in Canada may be in a position to consider using logs to build houses, as communities in remote areas are often surrounded by or are near forests. Communities are able to harvest on reserve land or obtain provincial harvesting permits for Crown land forests. Not all trees suitable for harvesting can be used for log home building, as trees used for log housing construction must be of appropriate length and straightness. As demonstrated by Eagle Nest Log Industries, however, if there are not adequate type or quantity of suitable trees, arrangements for suitable supply may be possible with forest companies. Tree agreements can allow for the exchange of trees suitable for the sawmill for logs that are appropriate for log house construction.

A variety of tree species are used to construct log homes. Environmental conditions, structural requirements, local availability and personal preference are all factors in the choice of trees. A search of various log home construction companies and log home associations in North America suggest the most commonly used species that are found in Canada include Douglas Fir, Englemann Spruce, Black Spruce, Hemlock, White Pine, Lodgepole Pine, Ponderosa Pine, and western Red Cedar.

These tree species are found in 5 ecozones in Canada. These ecozones (see Figure 5-3) are: the Boreal Shield, Boreal Plains, Boreal Cordillera, Montane Cordillera, and Pacific Maritime Ecozones. Other tree species in these ecozones could be harvested and exchanged for suitable logs if tree agreements with forestry companies were arranged.

Figure 5-3: Terrestrial Ecozones of Canada

Source: Canada Council on Ecological Areas

Nearly 80% of Aboriginal communities in Canada are located in forested areas. Approximately 1000 reserves contain at least 20 hectares of forested land and 240 First Nations have legal entitlement to more than 1000 hectares of forest on their reserves (Natural Resources Canada, 2001).

Figures 5-4 and 5.5 are maps of western and eastern Canada that show First Nation communities, cropland where straw may be a by-product, and forest areas where softwood makes up more than 20% of the area. The communities are classified by the number of dwellings as recorded in the 1996 Census of Canada (source: Statistics Canada). Using a geographic information system, communities were identified where forest areas and cropland were within a 15 km radius (considered to be a viable distance within which to source materials locally). CMHC created these maps specifically to support this Aboriginal Housing Assessment research using data from Statistics Canada (1996 census) and Natural Resources Canada.

Figure 5-4: First Nation reserves, dwelling count, softwood forest and cropland in western Canada

Source: CMHC 2004

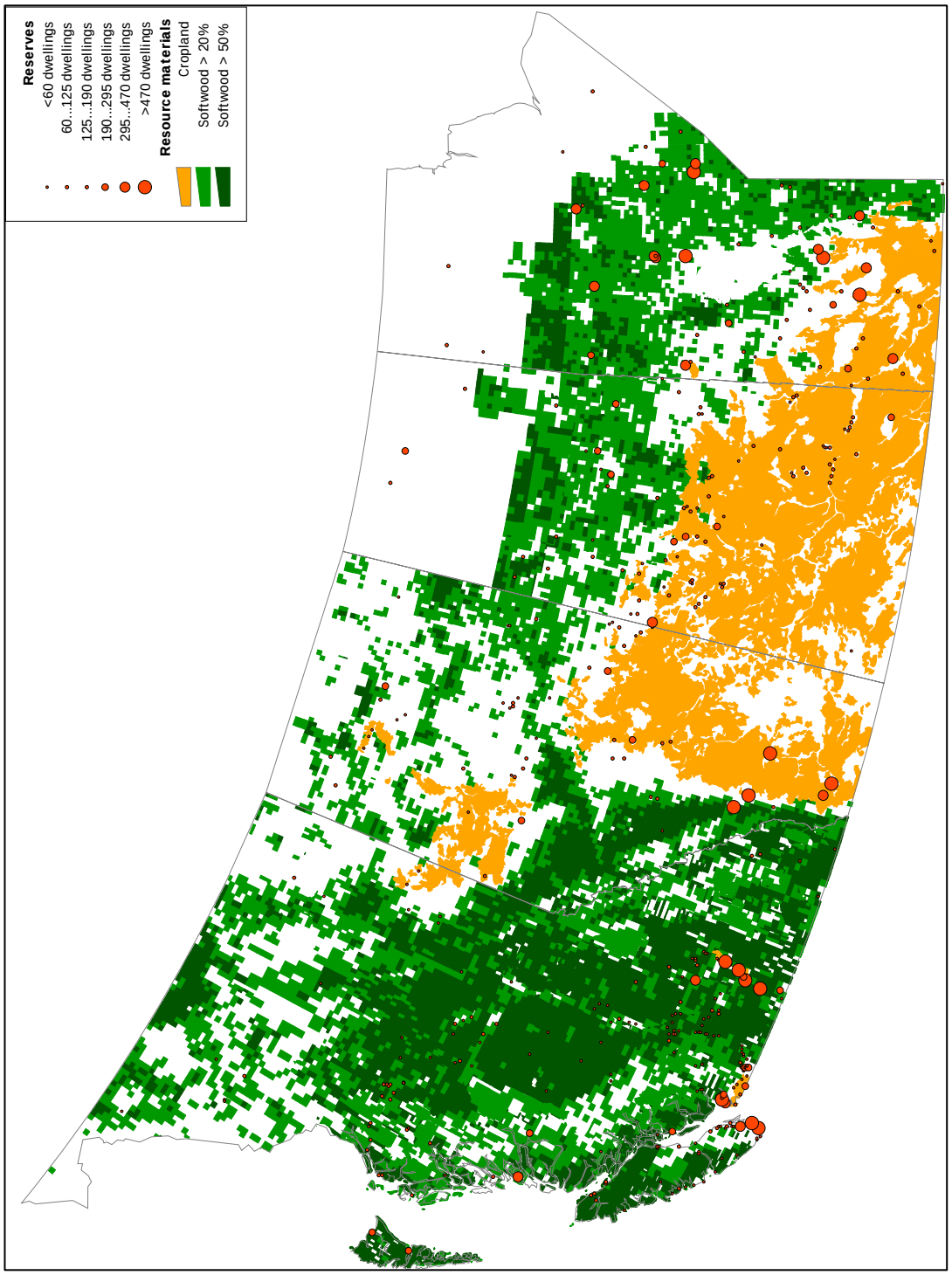


Figure 5-5: First Nation reserves, dwelling count, softwood forest and cropland in eastern Canada

Source: CMHC 2004

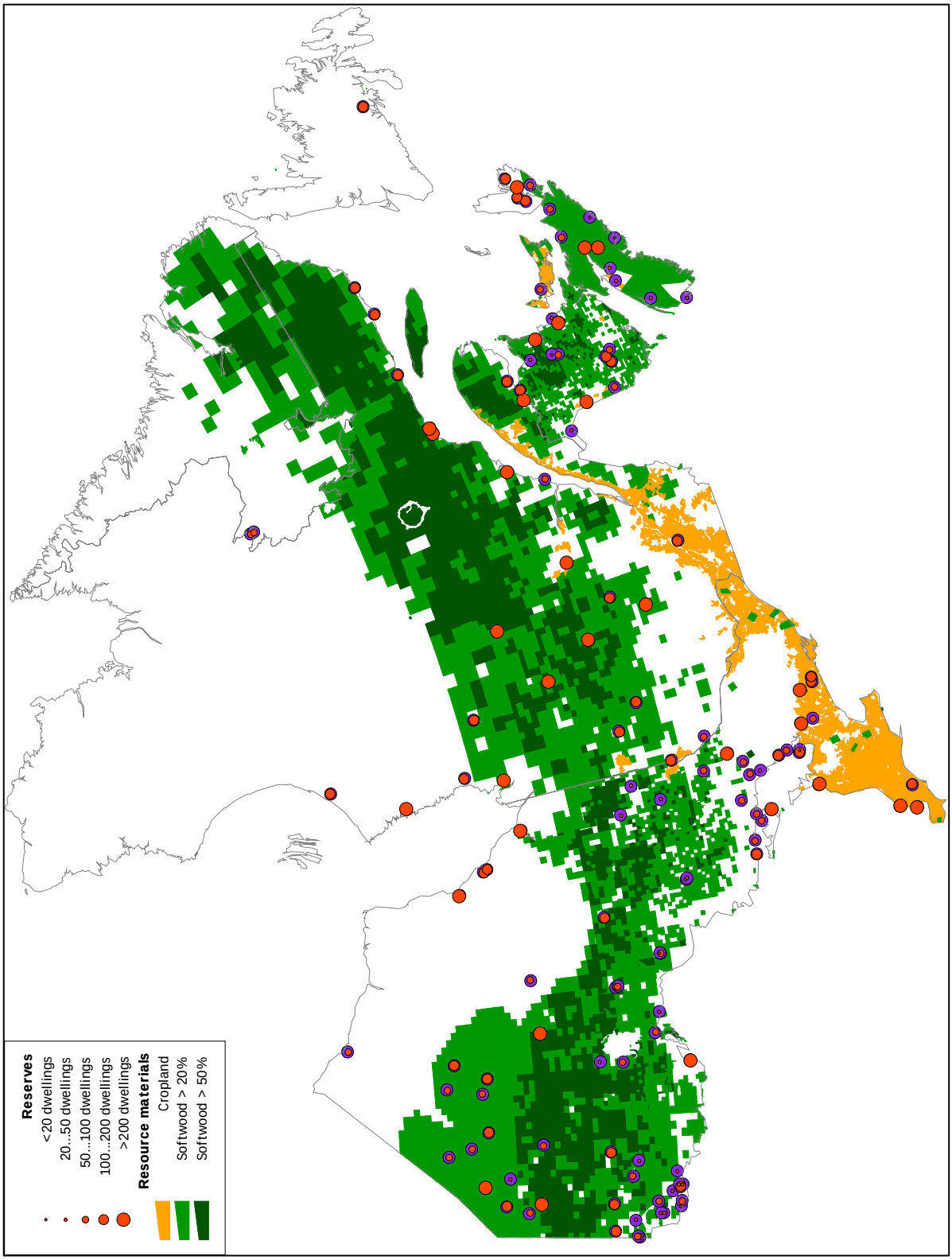


Table 5-1 summaries the number of existing dwellings on First Nation reserves that are within a 15km radius of cropland and/or forest areas with 20% plus of softwood. This table and the previous maps illustrate that there are many First Nations, all across Canada, near potentially viable sources of local housing material. Aboriginal communities with or near forested land that include suitable tree species could consider pursuing this source of local construction material. Log home building experience and / or training should be obtained to ensure the use of this material results in houses with the full benefits of log homes. In areas where suitable tree species for log homes do not exist, or in areas where trees are stunted or twisted, Aboriginal communities with access to forest could consider tree exchange agreements with forest management companies. Other questions that should be asked to determine feasibility are suggested below.

Table 5-1: Total Dwellings in First Nation Reserves within a 15km Radius of Cropland or Forest with 20% or more Softwood

	# dwellings near cropland	# dwellings near softwood forest	Total dwellings
Western Canada	25,390	29,815	47,625
Eastern Canada	5,140	12,610	37,935
Notes: 1. Some communities may be within 15 km of both forest and cropland. 2. Communities that did not participate in the 1996 census are not included.			

Source: CMHC, 2004

5.5.2. Local Clay

Specific conditions are required to produce this construction product, i.e. appropriate clay deposits and a clay product manufacturing plant. Unfortunately, the use of local clay resources to produce bricks for housing construction likely has very low feasibility for most Aboriginal communities. If these brick production conditions exist and local labour with bricklayer experience is available (or if training can be provided economically) brick house construction could be considered. This is the case in Sumas First Nation.

The types of clays used for bricks are known as common clays; shale, with its generally high content of clay minerals, can also be used to make brick (Coultier, *pers. comm*. 2003). Most Canadian clay or shale deposits suitable for brick manufacture are located in the southern regions of Canada (e.g. Nova Scotia; south-western Ontario, southern Quebec;; Regina, Saskatoon, Saskatchewan; Medicine Hat, Alberta; southern British Columbia). Brick manufacturing plants are consequently also located in these areas for proximity to the resource. Availability and access to clay resources in Aboriginal communities other than Sumas First Nation was not discovered during this research.

Access to locally available and First Nation-owned clay or shale resources (of the type suitable for bricks) in combination with the First Nation-owned brick plant are key components to the successful use of local bricks for housing. A suitable fuel source for firing the bricks is also required. If clay resources become available (for example, through a land entitlement agreement) the equipment to process the clay into bricks is not likely readily available to most Aboriginal communities in Canada. Traditional brick kilns, as are used in developing countries, are labour and energy intensive and have historically be a major source of air pollution in these countries and can also contribute to greenhouse gas emissions. Research to develop environmentally responsible traditional kilns exists and such a means of firing bricks could potentially be possible for Canadian Aboriginal communities with suitable natural resources, but without the capital for a large brick plant.

For communities near Sumas First Nation, purchasing bricks at reduced prices (as Chief Silver suggested would be made possible) from the Sumas brick plant may allow other communities to consider using brick. In the past, Sumas Clay Products has employed Aboriginal peoples from nearby First Nations. The feasibility of nearby First Nations building with bricks would improve if these trained employees were involved in brick housing initiatives in their own communities. Skill transfer to other community members could occur, labour costs could be reduced (as compared to hiring brick-layers), and financial resources could remain in the community.

5.5.3. Local Straw Bale

As a by-product of cereal grain production, straw is normally considered a waste material. Some of it is used for farm animal bedding, but the common practice for getting rid of the bulk of the straw material is by burning it off the fields, which produces air pollutants and greenhouse gas emissions.

Agricultural activity in North America produces almost 140 million tonnes of straw each year, with Canada accounting for 35%, or 48.3 million tonnes (Wilson, 1995). If a house can be built using 12 tones of baled straw (see section 5.4.2.1), then if all Canadian straw was devoted to home building there would be enough straw annually to build just over 4 million houses.

Farmland covers approximately 6.7% (67.5 million hectares (Mha)) of Canada's total land area. This is a little more than the size of the province of Alberta. Crops are grown on about 54% (36.4 Mha) of this farmland, with the largest cropland areas in Saskatchewan, Alberta, Manitoba and Ontario (see Table 5-2).

Cereal grains (wheat, barley, oats, rye), which are the tall stalk agricultural crops that later become straw, on average occupy approximately 49% of the land used to grow Canada's ten major crop species (others include soybeans and canola). In 2001, this 49% was equal to 17.8 Mha (Statistics Canada, Census of Agriculture 2001 in Wood and Layzell, 2003).

Table 5-2: Farm Land Area, Canada, 2001

	Area (Mha)						
Region	Total Land	FarmLand[2]	Crop Land[3]	Summerfallow	Tame Pasture[4]	Natural Pasture	All Other[5]
NL	41	0.04	0.01	0.001	0.003	0.007	0.02
PE	1	0.3	0.2	0.001	0.01	0.001	0.06
NS	6	0.4	0.1	0.001	0.02	0.03	0.2
NB	7	0.4	0.1	0.001	0.02	0.03	0.2
QC	154	3.4	1.8	0.01	0.2	0.2	1.2
ON	108	5.5	3.7	0.01	0.3	0.5	1.0
MB	65	7.6	4.7	0.3	0.4	1.6	0.7
SK	65	26.2	15.4	3.1	1.4	5.1	1.2
AB	66	21.1	9.7	1.2	2.2	6.7	1.2
BC	94	2.6	0.6	0.04	0.2	1.2	0.5
YT	48						
NT	135						
NU	209						
Canada	**998**	**67.5**	**36.4**	**4.7**	**4.8**	**15.4**	**6.2**

[1]Data source, Statistics Canada, Census of Agriculture, 2001
[2]Includes all farms reporting income from agricultural production.
[3]Includes all crops except Christmas tree production.
[4]Includes all tame and seeded pasture lands.
[5]Includes Christmas tree production.

Source: Wood and Layzell (2003)

Figure 5-6 is a map of the western Canada prairie region (Alberta, Saskatchewan, Manitoba) showing the land area in Manitoba, Saskatchewan and Alberta where straw can be sustainably harvested annually.

The statistics provided above and this map indicate that there is sufficient straw resources in Manitoba, Saskatchewan and Alberta to supply healthy straw bale home building in the straw harvesting region of these three provinces. It may also be economically and ecologically (i.e., limited greenhouse gas emission from transport) feasible for First Nation communities on the periphery of the straw harvest area in these three provinces to build homes with straw bales. And finally, it would be worthwhile to conduct a life-cycle costs analysis of sending straw bales to remote First Nation communities that have no local building material resource themselves.

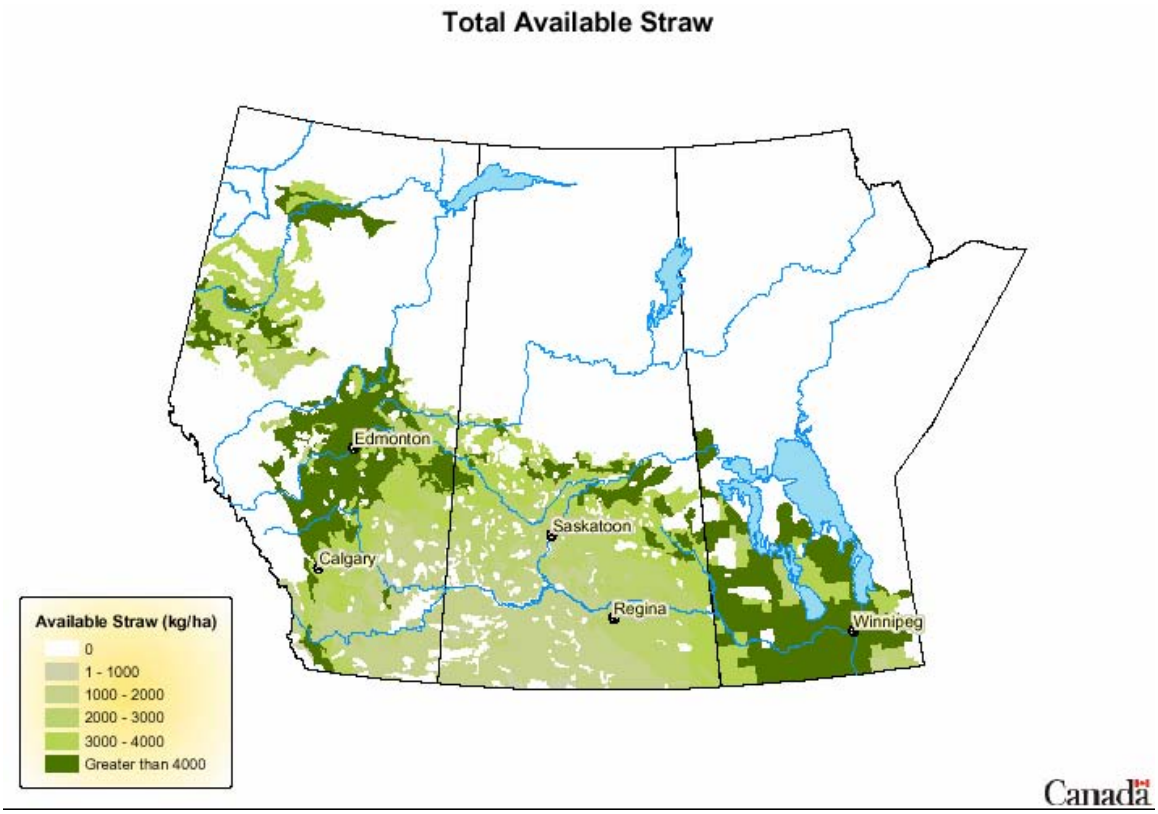


Figure 5-6: Total available straw (AB, SK, MB)

Source: Agriculture and Agri-Food Canada

5.6. Determining Feasibility of Local Material Use

After a construction material has been deemed geographically suitable, a community needs to consider other criteria to determine if it is feasible to use a local material for housing construction. In general the criteria fall into three additional categories: physical-technical, socio-cultural and economic. A series of questions are suggested to allow a community to determine whether or not pursuit of a particular local material is feasible.

The questions were derived from the successes and challenges experienced by the First Nations that were included in this research. The general questions a community interested in building with local materials should ask are outlined here.

Physical – Technical	Socio – Cultural	Economic
Is there a good source of the material available on reserve or close to the reserve (< 10 to 50 km, depending on material)?	Is there community acceptance of the local building material?	Can the majority of the housing construction be done using volunteer or apprenticeship-level labour?
Does the First Nation have access to the materials (legal and logistics)?	Is there First Nation government support for the use of local building material?	Are wages in the community such that local labour results in a savings over non-local, more experienced labour?
Is there capacity in the community to harvest and prepare the resource for building (labour and necessary equipment)?	Is there community interest in the project?	Is a capital investment needed? Does the housing construction justify the investment (cost-benefit analysis; full cost accounting)
Is there technical expertise available in the community to build the houses (construction and ancillary trades)? Are training opportunities readily accessible?	Does the initiative have a “champion”?	Is it eligible for program funding? Does it meet funding criteria: amount money; meets codes and standards; “modesty”.
Is there a work force in the community able to undergo basic training / apprenticeship to allow for local people to form the primary labour source?	Are community members interested in using local materials as a source of local employment?	

If a community were able to answer **yes** to these general questions, use of local materials for housing construction should be strongly considered.

In several cases there are strong connections between the three types of questions. For example, physical-technical and socio-cultural support in the community can improve the economic feasibility of construction in some instances. For example, the cost of housing can be reduced if local labour, trained to a basic skill level, can be used for the majority of the construction. Community interest in the project and the need for local jobs can result in reduced wages (as compared to market wages), acceptable of reduced gross wages and other means established by the First Nation to improve the feasibility of local material and labour projects.

5.7. Conclusions

Each of the participating communities and organizations expressed a preference for using local materials and local labour for housing construction. A variety of benefits were noted by the Chiefs, Councillors, labourers and residents who were interested and included benefits related to all aspects of sustainability: environment, economic, society and culture. Log (or timber derived from local forest resources) and straw bale houses have the widest applicability for housing in Aboriginal communities. Many communities live near forest and/or agricultural resources that could provide the raw materials. Both of these materials are renewable and could be managed to ensure the long-term availability and the overall heath of the environment. The training required for logs or straw bale is essential but could likely be obtained relatively easily and would result in a marketable skill that could be applied both in and outside of the community. There are many successful examples of communities, organizations and businesses using logs and straw bales from local materials for local housing.

The environmental benefits of using materials that are renewable (in the cases of logs and straw bale), that exist in close proximity, require minimal transportation and require minimal processes are clear. The economic advantages of using local materials are not known. The communities did not have comprehensive records of costs and an economic analysis of the local materials was not part of the scope of this research. Common sense would suggest that the economic benefits could be significant if the community owns the resource and can use trained, local labour to build the houses; housing funding can then provide jobs for local community members and can remain in the community to create a multiplier effect. Social and cultural benefits are realized when the housing construction provides local people with jobs that contribute to the community's well being, when local materials and designs are consistent with traditional methods, and when there is pride at being self sufficient and providing for community needs.

6. CONCLUSIONS

6.1. Significance of Research Findings for Communities

According to the participating communities **local materials** for housing construction bring environmental, economic, social and cultural benefits to the participants and the community as a whole. Decisions to use this approach to housing are seen as something that should be made with the participation and support of the community as a whole.

This research did not include feasibility studies for local materials or economic analyses. Nevertheless, **local materials** could be considered for housing construction in Aboriginal communities where a construction material is locally available, where trained labour exists in the community or where a local labour force exists and training can be accessed.

According to the participating communities, **current housing designs** are generally not meeting the needs of Aboriginal people. Participants had many suggestions related to the interior and exterior designs that would make their living spaces more suitable. Community members should ensure that they are included in decisions made by their government on housing. Aboriginal governments should continue to press for culturally appropriate housing.

Housing designs that are different from the standard “CMHC house” are the choice of many people in Aboriginal communities. People would like to participate in determining the design. The participants believed that participation in housing design would increase the likelihood of houses meeting their cultural and social needs.

6.2. Significance of Research Findings for Policy and Programs

Access to Training Opportunities: Housing construction with local materials such as logs and straw bales require some training and apprenticeship opportunities. Although these materials require perhaps less skill than others, attention to detail is essential for the benefits of these houses to be achieved. Provision of opportunities or resources to access training could be included in policy and programs and prioritized in communities with a viable resource (by First Nation and the Canadian governments).

Incentives for Use of Local Materials: To encourage the use of local materials and reap the environmental, economic and socio-cultural benefits, policy incentives could be researched and developed.

Linkages to Other Initiatives: Housing and the need for increased community participation and appropriate land-based planning should be linked to current

Comprehensive Community Planning initiatives, the First Nations Land Management Act, and movement towards self-governance. Existing and opportunities for linkages should be determined and pursued.

Clarification of Existing Housing Programs: There were many participants who were not aware of current CMHC programs for renovations or modifications to housing (e.g. RRAP, HASI). Information on funding programs for housing should be made available to both the Aboriginal governments and the community members.

Evaluation: Within the regular cycle of program evaluation, criteria relative to design and materials used in Aboriginal housing could be developed and added. Questions like – is the portfolio profile as built under programs a good match to the community profile – could be included. Given that the majority of the housing that gets built is program funded, it should match the community's housing needs.

6.3. Recommendations for future research

Review of Current Housing Policy and Programs: Current CMHC and Public Works and Government Services policies and programs could be evaluated to determine current barriers and opportunities. For example, in the case of brick homes in Sumas First Nation the consideration of brick as a deluxe material should not apply, given that the material is locally owned and processed. Policies and program areas that could be modified/changed to reflect the desire of Aboriginal communities for local materials and labour and alternative designs could be identified. These areas could then be addressed. Adaptations to housing codes or the requirement to meet housing codes to access funding resources could be considered. For example, in the case of Nibinamik First Nation the traditional methods of building log homes likely do not meet standard building codes but may be suitable and safe for the local community.

Develop Alternative Housing Designs: The alternative housing design needs and preferences expressed by the research participants could be used to create alternative housing designs. These designs could be vetted with research participants before they are finalized. Designs could then be provided to communities for housing contractors, and supported by funding sources.

Economic Analysis of Local Materials: An analysis of the true cost of housing construction with local materials (logs and straw) would provide for a better understanding of the benefits of using local materials. To accurately reflect these costs, and in a manner that reflects Aboriginal worldview and a holistic approach, the analysis should incorporate environmental, social and cultural costs and benefits (i.e. full cost analysis). Methods could also include Life Cycle Analysis (upstream and downstream environmental impacts of a product, project, or process over its entire life: extracting and processing of raw materials,

manufacturing, transportation, use/re-use/maintenance, recycling and final disposal).

First Nation Straw Bale Housing Initiative Pilot: Development of a straw bale housing initiative for First Nation communities in regions with access to straw, and partnership with two First Nation communities to pilot test the program. The program could be modeled after the success of Red Feather Development, which is working with American Indian communities to build straw bale homes and human capacity.

First Nation Log House Construction Training Opportunities: Partnerships should be created between INAC, First Nation organizations and training institutions (e.g. International Log Builder's Association, Manitoba Keewatinowi Okimakanak) to facilitate apprentice opportunities for interested First Nation members of First Nations pursuing log-housing construction.

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http://atlas.gc.ca

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www.johnco.com/newspage/housing1.html

Batchewana First Nation: Housing
www.batchewana.ca/housing.html

Builders Without Borders
www.builderswithoutborders.org

CMHC
www.cmhc.ca

Green Technologies for Northern Housing
http://homepage.usask.ca/~tjl128/engr/SRC/start_page.html

Homegrown Solutions
www.hgrown.org

Indian and Northern Affairs Canada
www.inac.gc.ca

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