



STRAW BALE BUILDING PRIMER

The Beauty of Straw

Straw is one of the finest, renewable building materials available and it is found around the world in abundance. It is the strong stalk of tall grain plants — such as wheat, rye, hemp or rice — that remains in the field after the seed grains have been harvested. Its chemical composition is primarily cellulose, just like trees. When bundled together into a bale it becomes a solid block that is highly resistant to decomposition. When assembled together like Lego™ and covered with a plaster skin, straw bales make a beautiful, strong, energy efficient and ecologically sound house.

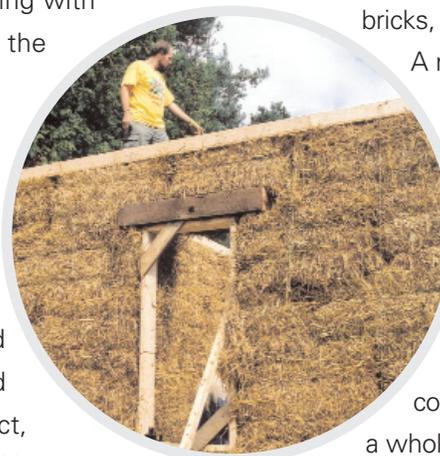
Solid History

The early settlers of the grasslands of Nebraska and western Canada discovered the beauty of building with straw bales over 100 years ago. Necessity was the germ of their discovery. Confronted with cold winters, a lack of trees, and a need for quickly built outbuildings, the settlers turned to the abundant straw to house their animals. They piled the bales, put on a roof and added earthen plasters. The result was superb. The insulation against the cold was found to exceed any wood building. The settlers then proceeded to build their homes with straw bales too. In fact, many of the original settlers' farm buildings and homes are still intact, standing as a testament to the material's strength and longevity.

Contemporary builders are waking up to its virtues too. With every year, people around the world are discovering the benefits of building with straw bales. Extremely energy efficient, they keep inhabitants warm in winter and cool in summer. No more excessive heating bills. No need for air conditioning. Straw bale construction has become an accepted part of building codes in several American states and municipalities. The number of Canadian straw bale buildings built in the year 2000 is estimated to have been greater than 1,000. Each year the numbers rise.

Basic Method

In the Ontario context, straw bale walls are built by stacking two-string bales of between 25 and 45 lbs each to the desired wall height in an overlapping bond, similar to laying bricks, but without the mortar in between.



A mesh reinforcement is attached to both the inside and outside surfaces of the wall and two coats of cement-lime plaster totaling 1 to 1 1/2" are applied. A cosmetic interior finish and exterior water protection is then added. Engineers term this type of construction "stressed skin". It creates a whole wall strength that is greater than the individual parts.

Save for the walls, straw bale homes are built in the conventional manner. Foundations, floors, roofs, electrical and plumbing are the same as in other homes, with only some minor variations. Electrical services are run between the bales or at the floor or ceiling using standard NMD wire. Electrical boxes are attached to stakes driven into the bales or attached to wooden beams and surrounded by plaster. Because of these consistencies with typical building practices, the prices for these components of a straw bale house are generally the same as for a conventional building.

Building Styles

There are two basic styles of straw bale construction. Both types have received permit approval in various regions of Canada.

Load Bearing

The walls of load bearing buildings actually completely support the roof and second storey floors if present without any posts or framing for support. A rigid plate is placed on top of the walls and cinched to the foundation by various means to secure the roof to the rest of the house and to mechanically remove any settling which may otherwise have occurred.

Plaster is then applied to both the inside and outside surfaces of the wall. In this style, the

completed wall serves as both structure and insulation. This style may use the least wood and may require the least carpentry skills although it may also need more effort to receive permit approval.

Post and Beam

Adopting a centuries old building technique, this style use a structural framework, most commonly made of wood, which supports the roof and subsequent storeys. The bales fill the spaces between the posts or wrap the entire structure. Here the straw acts only as insulation and a surface on which the plaster can adhere. This style uses greater quantities of

dimensional lumber although several different "modified post and beam" (such as our own "box beam" system) designs have emerged to satisfy building officials while reducing large dimension lumber use. This style permits installation of the roof, completion of electrical and plumbing rough-ins, and framing of interior walls, all prior to bale work.



Applications

Today, straw bale building has become very popular. Everything from garden sheds, garages, cottages, studios, and modest houses to grand mansions and large commercial buildings can be found in most Canadian provinces, U.S. states, Mexico, Australia, Europe and beyond.

Straw bales are also ideal for retrofit applications. Straw bales have been used to wrap the exterior of old, poorly insulated houses or the interior of large commercial buildings and warehouses in order to dramatically improve energy efficiency. Straw bale additions have been made to many conventional homes to easily create new spaces.

Entire straw bale subdivisions have been completed in the U.S. southwest. In Canada, a straw bale development has been planned in Regina and a large Toronto area developer is planning to build a sales office with straw bales to promote the same in this area.

Our own demonstration projects at the Toronto Fall Home Show ('01), Ottawa Cottage and Country Homes Show ('02) and the Toronto Royal Winter Agricultural Fair ('03 & '04) were among the most popular exhibits. Home Alive! – The House that Thinks, Drinks and Breathes is our first attempt at prefabricated straw bale buildings and after its enormously successful launch as a feature home at the National Home Show (03) it has reopened as a permanent demonstration house at the Everdale Environmental Learning Centre.

Big business is also recognizing the direct benefits and resulting goodwill that accompanies straw bale construction. Mountain Equipment Co-op used straw bales in constructing

part of one of their large-scale retail stores in Ottawa. Several architecture and engineering firms in Canada specialize in straw bale designs. A host of Canada Mortgage and Housing Company (CMHC) studies have confirmed straw bale building to be a viable, safe building material and method for Canadian climates.

Clearly straw bale building is fast finding acceptance with a mainstream audience. Demands for construction is so great in some areas of Canada that there are not enough straw-bale specific contractors to perform the available work.

Common Concerns

Straw not Hay

Hay is for horses! Hay includes grasses like alfalfa, is cut wet and generally used as animal feed. The plants comprising hay are commonly allergenic. Straw is the strong stalk of tall grain plants and is primarily a cellulose - just like trees - tough, fibrous and without food value. In fact, a bale of straw is like a dense block of thousands of little trees bound together.

Height Limitations

Multiple storey mansions, office buildings, light commercial warehouses and showrooms have all been built with straw bales. Given that straw bale walls have been shown to be at least four times stronger than a conventional 2x6 frame wall, there are no special limitations to the height of a building.

Rot

Water is the single largest threat to all buildings - straw bale, steel and wood alike. With the correct design and construction measures taken, straw bales will last a lifetime in their secure environment. Canada Mortgage and Housing Corporation (CMHC) has conducted studies that prove straw bale building's suitability in all Canadian climates.

Allergy/Asthma Sufferers

Generally speaking, there are no allergies to straw although dust and stray weeds embedded in the bales can cause those with environmental sensitivities trouble if actually

assisting with construction. Once plastered, the bale walls are a clean, inert and hypoallergenic system that, together with other material choices, can provide excellent indoor air quality often without the need for mechanical air exchangers.

Fire

The compactness of the straw, combined with the coating of plaster does not provide sufficient air to support combustion. CMHC tests demonstrate a lower fire risk when compared to conventional construction materials and methods and provide straw bale walls with a 2-hour or commercial fire rating.

Pests

Little critters love the open spaces provided by wood frame buildings. Straw has no food value to attract mice or insects and they would first have to gnaw their way through an inch of plaster to access the straw. It is ideal for areas at high risk of termites, as straw does not suit their palette.

Permit Approval

Straw bale building's growing acceptance into mainstream practices has seen some U.S. states include straw bale construction into their prescriptive building codes. In Canada there are Engineers and Architects familiar with straw bale building who will provide their recognized professional stamp to indicate the soundness of the planned structure which will generally assist with the approval process. Even having built in large urban areas, we have never had a problem receiving a permit for our clients' projects.

Structural Strength

Unlike wood frame construction that has low tolerance to extreme lateral or lift forces such as tornadoes or earthquakes, straw bale buildings' continuous monolithic plaster provides extraordinary strength and elasticity in the face of such forces. They can actually flex and bend but resist collapse making straw bale buildings ideal for quake, hurricane or tornado prone areas.

Longevity

Like all types of building materials, straw has its special considerations for construction and upkeep. Straw and cement-lime plasters have been used for centuries on buildings still standing in areas such as Europe and Central America. Built and maintained properly, straw houses have the potential to far outlive conventional buildings.

Pinning

Early literature speculated that straw bale walls should include steel or bamboo "pins" to reinforce the walls. On-going independent tests prove that the plaster provides most of the wall strength and that foundation pins or wall pins are an unnecessary use of both material and time.

Harvest Homes

Elegant. Efficient. Ecological.

Harvest Homes offers the most comprehensive ecological building services in Ontario, Canada and Central America. We are known best for our straw bale structures. However, we are much more. Our services include building design, contracting, construction, product sourcing, teaching and consulting. We have two experienced building crews. We carry a good selection of eco-building materials and finishing products. And we have expertise in installing ecological systems (wind and solar power, water collection and waste systems, and energy efficiency) into homes new and old.

Our portfolio ranges from simple outbuildings to elaborate and automated structures. If you're looking for a responsible and experienced company for your ecological building project, you've come to the right place.

Services

We offer full construction services with an experienced and accredited work crew. We have built load bearing and post-and-beam styles. We are available as exterior wall systems sub-contractors, or we can do the full nine yards, from the foundation up. You may choose to work beside us

or bring in your family and friends for the wall raising or other jobs. We are happy to work alongside you and any other volunteer help. It's up to you.

Planning & Design

- Initial Consultation
- Design
- Building Code Approved Plans

Project Management & Construction

- Project Management
- Bale Raising
- Plaster Spraying
- Stucco Finishing
- Carpentry
- Specialty Tradespeople (energy systems, mosaics, custom cement)

Consultation

- Initial Consultation
- Healthy Home Evaluation
- Professional and Product Referrals

Please use the attached Preliminary Checklist before contacting us to discuss your straw bale building or eco-renovation project. It will help us to start our discussions and help you evaluate your needs.

Harvest Homes Preliminary Checklist

Your Information

Name:
Phone (Day):
Phone (Evening):
E-mail:

Checklist and Project Information

- Do you have your architectural plans in hand? Yes / No
- If yes, what is the square footage and height? _____
- If no, what are your needs and the desired dimensions of your project (square footage, rooms, etc)?

- Does your architect have experience designing for straw bale buildings?
Yes / No
- If yes, what is the architect's name and contact information?

- If no, would you like us to recommend an architect? Yes / No
- Do you have an engineer who has experience with straw bale buildings?
Yes / No
- If yes, what is the engineer's name and contact information?

- If no, would you like us to recommend an engineer? Yes / No
- Do you have bank financing? Yes / No
- If yes, what is the pre-approved mortgage amount? _____
- If no, how will you finance the project? _____
- How much have you budgeted for the construction? _____
- Have you contacted your municipality and asked them about obtaining a permit for building with straw bale? Yes / No
- If yes, what is the municipality's response?

- If no, we recommend you take this step to help us evaluate if there will be any obstacles or delays in obtaining a building permit.
- Do you want to participate in the construction? Yes / No
- If yes, in what capacity?

Building a New Home

- Do you already own the land where you intend to build? Yes/No
- If yes, describe the land (lot or acreage size, plus distinguishing geographic features/obstacles):

- If no, describe the type of land you are seeking and when you plan to buy:

- When are you planning to build? _____
- When do you want to move in? _____

Eco-Renovating with Straw Bales

- Where is your home located?

- What are the current materials of your home?

- How large is your home? _____
- How old is your home? _____
- How large of an addition do you want? _____
- Please describe the type of renovation you would like?

- Have you contacted your municipality regarding a building permit? Yes / No
- If yes, are there any restrictions that apply?

- When would you like this project to be finished? _____
- When can the renovation start? _____

Questions?

Please list the questions you wish to ask us below. This will help us prepare for our first discussions and ensure our time is spent effectively moving you closer to your project's next step.

The same checklist is also available online at www.harvesthomes.ca/checklist so that you can fill it out and send it electronically. During the building season, we may be tardy in our response while tending to the needs of our current projects. If you require urgent response please call us directly and we will respond within two business days to set up an appointment to discuss your project, either by phone or in person.

Harvest Homes

Phone: 519-242-4681

E-mail: info@harvesthomes.ca

Straw Bale Bibliography and Resources

Books and Magazines

Natural Home Magazine

Resplendent with ideas, product offerings and inspirational pictures of all varieties of "greening" a home or office, this magazine is bringing green mainstream.

www.naturalhomemagazine.com

Straw Bale Building: How to Plan, Design and Build with Straw

By Chris Magwood and Peter Mack is one of the most up-to-date additions to straw bale literature and is specific to northern climate considerations.

<http://www.newsociety.com>

The Last Straw Journal

A must for the aspiring bale builder, this quarterly journal is rife with insightful articles by experienced builders and do-it-yourself homeowners alike. Back issues available on CD-ROM. www.strawhomes.com

The New Straw Bale Home

By Catherine Wanek of Black Range Films

A perfect coffee table type book with wonderful pictures and inspirational stories of owners and builders across Canada, the U.S. and Europe.

<http://www.strawbalecentral.com>

Helpful Websites and Organizations

Canada Mortgage and Housing Corporation (CMHC)

<http://www.cmhc-schl.gc.ca/>

Listserves

These two strawbale listserves feature many old hacks offering their advice. A few Canadians are onboard too. Be ready for many emails to fill your inbox should you subscribe

<http://www.repp.org/discussiongroups/>

www.groups.yahoo.com/groups/sb-r-us

Ontario Straw Bale Building Coalition

Ontario Straw Bale Building Coalition (OSBBC) provides information for people with an interest in building and/or owning a straw bale home. As well, it aims to foster a community of builders and owners involved in straw bale building to promote the exchange of ideas, resources, and social opportunities.

<http://www.strawbalebuilding.ca/index.shtml>

Surfin' Strawbale

Perhaps the best set of links to straw bale building sites anywhere but not specific to Canada and many may be broken.

<http://mha-net.org/html/sblinks.htm>

Research Documents

Energy Use in Straw Bale Homes

A CMHC sponsored investigation of the amount of heating energy required for several Canadian straw bale homes relative to similar conventional homes

<http://www.cmhc-schl.gc.ca/publications/en/rh-pr/tech/02-115e.pdf>

Moisture Properties of Plaster and Stucco for Straw Bale Buildings

http://www.cmhc-schl.gc.ca/publications/en/rh-pr/tech/00-132_e.pdf

Straw Bale House Moisture Research

http://www.cmhc-schl.gc.ca/publications/en/rh-pr/tech/00-103_e.pdf

Straw Bale Moisture Sensor Study

This study by early Canadian straw bale builder Kim Thompson of Nova Scotia is hosted online by the Masonry Heater Association

<http://mha-net.org/msb/html/papers-n/strwmoist/strwmoist.htm>

Wood Use in Straw Bale House Construction

<http://www.cmhc-schl.gc.ca/publications/en/rh-pr/tech/02-116e.pdf>

Videos

Building with Straw Bale (Three volume set)

Three interesting videos on different aspects of straw bale building, including a how-to workshop, a tour of many existing homes, and a guide for straw bale code testing.

Black Range Films

www.strawbalecentral.com

Other Canadian Resources

Archibio

Montreal bale designer and instructor's company home page

www.archibio.qc.ca

A Small Urban Montreal Lot

A small lot proves plenty for this house, a two and a half storey, single family home of straw bale infill in wood frame construction.

(Aussi disponible en français.)

ww2.mcgill.ca/mchg/straw/index.htm

Ecobuildings

Calgary architect and professor Jorg Ostrowski's home page that includes several straw bale buildings.

www.ecobuildings.net

Green Planet Homes

Shawn Hayter is continuing to work with Harvest Homes until the launch of his own business in Western Canada in 2005-6

www.greenplanethomes.ca

Kim Thompson's House

Kim tells the story of her pilot Nova Scotia house and provides links to other sites of interest.

www.chebucto.ns.ca/culture/shifting_boundaries/sh-portrait2.html

Masonry Heater Association

Perhaps the best set of links to straw bale building sites anywhere but not specific to Canada.

<http://mha-net.org/html/sblinks.htm>

Sustainable Works

Habib John Gonzalez

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