



Building Your Straw Bale Home

From Foundations to the Roof

Brian Hodge

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Foreword

Humans have a long history of using straw in one way or another in the construction of shelters. The use of straw in a baled form for wall construction was pioneered by the early settlers in America out of a desperate need to protect their farm animals from severe winter cold weather, and the practice was later extended to build houses for humans. That was more than a century ago.

Our recent rediscovery of straw bale construction is largely derived from the realisation that our way of living is not sustainable if we keep doing things as we do now. Resources that support our materialistic lifestyle are depleting fast; animal species that are a vital part of our living environment are becoming extinct at an alarming rate.

Providing safe shelters has always occupied a position of utmost importance in any culture and in any society, be it simple or complex. However, in our effort to achieve that goal in a modern society, which is spreading fast all over the globe as traditional society is taken over by western influence, we are contributing to the destruction of our mother earth. Construction activity is the single biggest contributor to global warming.

Straw bale is a renewable resource. Compared with timber, which is regenerated typically every 20 to 30 years, straw is generated once or twice per year. As long as people need grain as a food source, straw will be generated as a by-product. Straw in many parts of the world is still regarded as a waste. Even its disposal has become an environmental issue, like burning in the field. On the other hand, straw has certain excellent properties as a building material, such as its thermal capacity. In baled form, it keeps its integrity reasonably well. Once rendered, straw is durable and strong.

Straw bale building has seen a renaissance in recent years. It is spreading fast like a wildfire to every corner of the earth. *Building Your Straw Bale Home* is a how-to book for people interested in straw bale building. It is a practical book reflecting the author's personal experience, with tips and wisdom learned from his own pitfalls and mistakes. The book deals with every facet of building a straw bale house, from council approval and insurance to construction and finishing. The hand-drawn illustrations in the book are most informative.

Importantly, this book is written in the context of Australian building practice, which is quite different from the practice in America or Europe. With admiration, I present to you this practical text on straw bale building. Believe me, you will be 'bitten' by the straw bale bug once your eyes open to the wonderful world of straw bale building. You will be infected and become a 'baler'.

Dr John Zhang

Hillbridge Designers and Engineers

May 2006

Preface

Brian Hodge is a builder of some 30 years' experience, and has been involved in many aspects of the building industry – from levelling houses for the South Australian Housing Trust and replacing windows, to solving various building defects and helping owner-builders realise their dreams.

This book covers construction methods used in the standard processes of building. In the first chapter, 'Councils and straw bale houses', Brian discusses the various roles of architects, designers, engineers, certifiers and council officials. There is a simple way to succeed – use professional people who understand straw bale construction to document, approve and help build your home.

Site selection, the implications of sloping sites on construction costs, how to manage difficult sites and the importance of soil tests are covered early in the book. Chapter 3, 'Floors and foundations', has a very detailed description of stump and bearer construction, which is a widely adapted practice in Victoria, and a short description of concrete footings and slab construction. Brian provides an interesting comparison of the thermal properties of timber and concrete floors that should start many discussions among the design fraternity. As a matter of particular interest, Brian has just received a 5-star rating on a straw bale house with an insulated timber floor that is to be built in Churchill, Victoria.

I found Chapter 4, 'Straw bale walls', to be the most interesting and informative chapter. It describes the three wall types – loadbearing, infill straw bale and structural infill straw bale. Together with Chapter 5, 'Window and door openings', these two chapters give a detailed description about selecting straw bales, raising walls, compressing walls, lintels, and fixing windows and doors to straw bale walls. The important issue of weatherproofing wall openings is also covered.

Chapters 6 to 9 provide the reader with a carpenter's manual of constructing wall, ceiling and roof framing, and a description of the Kram internal walling method. This construction is commonly known in the building industry as 'first fix' or 'frame stage'. Chapter 10 then discusses the 'second fix' or 'lock-up stage' of carpentry, covering the installation of doors and windows. The installation of internal doors and the construction of staircases are covered in Chapters 14 and 17. Brian concludes this section of the book with a chapter on purchasing building materials, including second-hand materials that have many pitfalls. These chapters on building construction will be most useful to both owner-builders as well as students of building construction.

Brian also pays close attention to the proper installation of services such as electrical conduits and plumbing pipes, as both can cause moisture to build up in straw bale walls

and ultimately cause the walls to fail. Interestingly, the book mainly covers earthen rendering of straw bale walls. There are other rendering techniques, including cement and lime render, but Brian does not cover them in great detail. Owner-builders, however, should be aware that other options are available. Inadequately rendered walls can lead to problems other than those caused by moisture. In Chapter 16, 'Mice', Brian tells us a story about mice making their home in a cosy straw bale house, entering through a poorly rendered section of a wall near the floor joists. Despite further rendering, the mice survived by drinking water that condensed on cold water pipes. Thankfully, he also tells how the mice were finally evicted.

This book is a good reference for anyone who has a desire to understand building construction or a desire to build a straw bale house to a high standard using well-researched methods.

Bohdan Dorniak

Architect

Townplanner

Licensed Builder

Designer of over 50 straw bale projects

President of Ausbale (The Australasian Straw Bale Building Association)

Introduction

Before venturing into the expedition of new developments within straw bale construction, it is imperative that all readers understand that this is not a new building system. Building with bales of straw has a successful history of over 100 years. Our ancestors were not bogged down with rules, regulations public liability insurance and the fear of litigation; they simply had a need to keep warm and dry. They were a people deeply reliant and connected to God and the land, and were totally reliant on both for their survival. They understood the concepts of cause and effect. They knew from experience that for the roof to withstand the pressures of the elements its timber frame would need to be a particular size. Most people think that this art died out a hundred years ago, but they are mistaken. The light timber framing code that specifies what size timber to use in particular applications did not exist in the 1960s. I often hear it said, 'they don't build houses like they used to'. My answer to this is 'thank goodness'. There is no doubt that the houses built since the inception of the timber framing code and a range of other codes are significantly stronger than their predecessors. Yet we cannot ignore the physical proof that the early buildings still standing, stand as monuments to their builders' understanding and capacity. It is for this reason you can be confident in your financial security in investing in a straw bale home.

Notwithstanding the success of early straw bale builders, I applaud the modern day adventurer in the development of our modern day straw bale building. Today, more so than ever before, we have the capacity to calculate and test our building systems. At the University of Western Sydney, straw bale walls have been built within huge testing frames with pressure applied to the wall, the outcome is then digitally monitored for future engineering scrutiny and referral. Rendered walls have been tested for fire resistance and heat transfer. Not only are the actual walls tested, but also all the other components that make up a house thus ensuring everything meets the requirements of the relevant building code. Today is a day of information and technology, and today's straw bale buildings are part of this. You have every reason to be confident in the longevity of your new straw bale home. Those built by the simplest method without the technology and information that we have at our disposal have lasted over 100 years, who's to say how much longer our new buildings will last.

The materials available to builders today are far greater than even 30 years ago when I first started working in the industry, and the range of products grows yearly. The incorporation of these new materials are heralded by some and snubbed by others. We walk a fine line between embracing all without question and throwing out the baby with the bath water. Many of the new materials are, to say the least, ecologically unsavoury. It

may however be the embracing of some of these products that will increase the life expectancy of our new generation of straw bale houses. If the ecological issue is only its longevity in our landfill, perhaps these may well be the type of products that are ideal for use in the construction of a dwelling that we want to last forever.

The aim of this book

While I am concerned about the ecological issues associated with providing housing for our population, I will not delve into that area in this book. There are many people much better qualified than I to deal with these issues. This book is written in response to the request by many owner-builders for uncluttered information on how they can build their own home. It is not an encyclopaedia of all of the research into straw bale construction or the various approaches to straw bale construction. There is a wealth of information available in good books and on the Internet that provide a broader approach to straw bale building, many of these are listed in the rear of the book. The recommended construction systems described in this book are not merely theories that should work; they are tried methods, which have been incorporated into real buildings that stand today without sign of failure. They are methods established from research and consultation with structural engineers – people with a deep understanding of the properties of straw, having had many years of experience in the design and manufacture of straw related products. These are people at the cutting edge of technology, who will soon release new straw products with huge ecological and structural benefits to the building industry in general. Overlay this knowledge with 30 years of personal experience and you have a clear and concise description of how to build your straw bale home.

The aim of this book is to provide you with the basic information required to build your own home. In my training courses I explain to people that they should be able to build a simple straw bale home after reading the book and completing the training course. I am constantly amazed at the capacity of my owner-builders. The homes they are building range from 9 squares to 38 squares. I am constantly encouraged by the strength of character and determination that they exhibit to fulfil the dream of building their own homes. I count it a privilege to be able to contribute to their capacity to achieve their dream, and trust that this book will inspire you with the confidence that you too can live the dream of building your own straw bale home.

The costs of straw bale houses

One of the most common questions I am asked is ‘how much will it cost to build my own straw bale home?’ This question cannot be answered without information that is not available until the design is completed and the site chosen. However, in an attempt to provide an idea of what is possible, I have listed the costs associated with the actual construction of a two-bedroom, one-bathroom home of approximately 95 square metres (10 squares), which was completed in 2005 by my son, Brad Hodge. All costs listed below and elsewhere in this book are in Australian dollars.

The home is a load-bearing straw bale home with a timber floor supported on concrete stumps. The costs listed are related to everything within the building envelope

including the gutters on the roof. It does not include the cost of the septic tank, the power connections to the property and other site-specific costs. While it does include the cost of plumbing and electrical work within the house, it should be noted that a friend fitted the roofing iron and gutters at no cost, which would have otherwise cost approximately \$1000. Furthermore, the electrician allowed the owner to provide their own labour to fit the cables into the wall, which would probably equate to savings of \$300–400. The costs related to bank fees, engineering, drafting and the actual building permit are also excluded, and, obviously, given that Brad is my son, I did not charge him for my consulting services. Just prior to building this home Brad was a manager of a retail outlet. Brad's main attributes regarding the construction were his determination and rational approach to construction. Brad had no previous building experience so this house is an example that could be duplicated by any rational owner-builder with the drive to achieve the end result. Brad was given a second-hand upright oven, and using second-hand windows, doors and roofing iron reduced costs further. Apart from these, all materials were purchased new.

Building costs for the two-bedroom, one-bathroom, 10 square home in Heathcote, Victoria, completed in 2005.

Timber and roof trusses for the house frame	\$6538
Straw bale walls and render	\$2358
Lock-up, including second-hand windows and doors	\$651
Fix – internal doors, ceiling linings, etc.	\$1503
Fittings, including bathroom, kitchen, laundry, toilet and hot water service	\$1094
Electrical	\$3362
Plumber	\$5092
Insulation	\$766
Miscellaneous	\$440
Total actual house cost	<u>\$21,804</u>



Figure I.1 The straw bale home in Heathcote, Victoria



Figure 1.2 The lounge room of the straw bale home

The three construction methods for straw bale houses

Straw bale houses are constructed in one of three different methods. The first and oldest method is that of load bearing. As the name suggests, the bales of straw support the roof. The second is infill construction. This has been particularly popular in the revival of straw bale building, as it has been easier to convince the regulatory authorities that this is a structurally sound system. This building type has either a steel or timber structure that is totally self-supporting with the straw bales fitted between the supports to fill in the gaps. The third method is a combination of both of the above, and is referred to as structural infill. The structural infill home has a substructure to carry the vertical load of the roof and/or upper floor joists, however it is not self-supporting. As opposed to infill construction, it has no bracing to provide the lateral stability of the structure. This lateral stability is achieved through the installation of straw bales into the walls.

The two major threats to a straw bale house

1. It is widely accepted around the world that the primary enemy of a straw bale building is water. Because straw is an organic material, the introduction of moisture will promote the organic breakdown of the straw. This is also an issue for timber frames, although it takes considerably longer for the long-term affects to become evident. In many ways it is an advantage that straw responds more quickly, as greater care is taken to avoid the problem in the first case. In the chapters following, I will

explain the hidden traps in construction that might result in the increase of moisture in the bale walls, and how to avoid them.

2. In Australia termites are a constant threat to buildings. These creatures were created to clean up the timber on the ground so it can return to the soil to be the source of nutrients for future trees. We have interrupted the natural cycle and built houses in the place of forests. Their creator programmed them to eat timber and some to eat grasses. The original programming has not been altered just because we changed their environment, so now they eat the timber in our houses, which to them is just as good as fallen timber on the forest floor. The use of treated timber and steel in the frame of a house is a short-sighted solution, for they will merely move onto the next available timber. The only solution is to prevent their entry into the house. Given this solution, I believe the most appropriate solution financially and ecologically is the use of untreated plantation timber in the frame of the house.

Questions to ask yourself

1. Do you have the physical capacity to lift a bale of straw?
2. Are you a rational person? Building a house is the most rational thing you will ever do. It is all about cause and effect.
3. Are you a good communicator? You will have to negotiate with suppliers, contractors and probably the building inspectors. To get upset and shout doesn't achieve anything in the building industry. This is an industry that does not respond well to bullying.
4. Are you humble? To be a successful owner-builder you will have to acknowledge your inadequacy and need for help. Many times throughout the construction of your home you will be unsure of what to do next. It is imperative that you seek help rather than press on and make mistakes that might cost thousands of dollars to rectify.
5. Do you have the financial capacity to see the job through to the end? When building, particularly for the first time, there are always hidden extras. Make sure that you have the capacity to cover the extras. I would strongly recommend that you allow a minimum of 10% over and above your estimated costs to cover the unavoidable, but don't use this allowance as an excuse to be sloppy in your costing of the job.
6. Do you enjoy a challenge, or are you going to collapse at the first sign of hardship? Building your own home is the most challenging and most rewarding thing you will ever do. For the average Joe, it is like climbing Mt Everest. It will make you hurt. It will make you cry. It will probably cause you and your partner to have disagreements. But most of all, you will never forget the elation from the view from the top of the mountain of completion. The difference between this and Mt Everest is that you get to live in that victory for as long as you choose.

The joy of building your own straw bale home

The one thing that cannot be adequately explained in the pages of a book is the emotional environment that can be created in a straw bale house. I can explain that the walls can be as lumpy or as smooth as you like in white, brown or any other colour. The surface of the walls can have a smooth metal-trowelled finish much like that of concrete

or a rougher foam block finish. You can have skirting and architraves or simply blend the render into the windows and floors. You can include beautiful sculptures into your walls or cut niches into the walls to hold your most prized possessions. You can have a flat roof or a steeply sloped roof. You can have timber ceilings or flat plaster. All of these things are true, but none of them explain what it is like to live in a straw bale home. I am yet to meet a person who has lived in a straw bale home who then wanted to return to living in the conventional brick veneer house. There is a peace and tranquillity that cannot be explained. I don't know whether it is because of the lack of chemicals in the wall, the soft appearance of gentle undulations in the walls or the sense of security that comes from the deep mansion-like walls. If you are yet to experience life in a straw bale home, do yourself a favour; rent one for the weekend. While the numbers are still limited, there are straw bale bed and breakfast facilities throughout Australia and I have no doubt other parts of the world. Track one down and set aside time to live the experience. Take a good book, playing cards, a board game or two, or maybe some sweet smelling candles and take the time to breathe in and out. Leave the rat race to the other rats for a weekend or better still a week or two. You will never regret it.