

Episode 228

How do you build a straw bale house? – with Barbara Jones

The show notes: www.houseplanninghelp.com/229

Ben: So, what was the moment then, that you decided it was going to be straw bale all the way?

Barbara: I've been working in construction nearly forty years now. I'm trained in carpentry and joinery and I can do pretty much anything on a building site. But in 1994, I took a year out because I was starting to become aware of environmental issues.

I travelled around the world looking for what were other people doing, because there wasn't much going on in the UK. I did a two day course in straw bale building in California thinking, great, it might work well over there, it won't work in England, and honestly, two days and I was totally inspired by it and I knew this was the thing I had to do.

Ben: What was it in that course that triggered, 'this is going to take me forward'?

Barbara: Well, it's actually an all women course and in two days, we put the walls of a small studio up. It was so fast, it was so precise, it worked, and you didn't need a frame. It was load bearing straw and you just put the roof on top and that was it. So simple and quick and anybody could do it.

Ben: You've mentioned to me that there are four different approaches when you're using straw bale. So, maybe you could lead us through those first of all?

Barbara: Of course, the original one was the load bearing method, the Nebraska Style it's called, that doesn't have a frame at all, where the structural ability of the straw to take the weight of the floors and the roof is used to make simple buildings which can be actually quite large and two or three storey. They just don't have a frame.

After that, there started being quite a lot of timber buildings which adapted to use straw, particularly in the USA, and so we'd call

those in-fill buildings, where the straw's just being used as an insulation block rather than a structural block as well.

Then a lot of what we do is a mixture of in-fill and load bearing because we might want, for instance, to have the south wall all timber and glass, and then the rest of it can be load bearing. We call those hybrids, where you've got a mixture of different techniques.

And then now I'm really pleased to say that there are a few companies in the world, and we're working with one of them in Lithuania, Ecococon, which has made pre-fabricated straw panels to a very high standard. I think this is what the mass market has been waiting for, is the ability to make modular houses very quickly and assemble them on-site in three or four days.

Ben: How are they making it into a simple form that you can just lift into place? What does it need to go through?

Barbara: They use the big round bales, not the small bales that we use, and that a lot of other pre-fab companies use. They unroll them in a warehouse, and then through a factory process, a machined process, they transfer that straw into a wooden box. So, if you imagine an empty box with open sides, so it's got four pillars at either corner, of three-by-twos – I should say seventy-five by fifty's ...

Ben: Very good. I'm glad you know the alternative. Most people don't. They just know one way.

Barbara: Yes, I speak both languages – and it has a board top and bottom. And so, the straw is packed into that box, that panel, to a very precise density and a very precise moisture content. So, it's not a bale in a box, it's straw in a box. And it's engineered so that you could build whatever you want to build without the straw being there. So, that really helps engineers who don't like straw because they find it hard to quantify.

But they've been tested on everything. Everything that's required to get them through building regulations, and they can meet Passivhaus standards without blinking.

Ben: How do they make sure that it's all compressed in a good way? Do you have to be very careful about the bale to begin with?

Barbara: Obviously, they only use dry straw. So, they already know the moisture content by testing it on the round bales, and then they use a factory press to compress the straw into the box. So, they're

reaching a density of around a hundred, hundred-and-twenty kilograms per cubic metre, and it's standardised so every box is the same. There's no gaps, no airtight issues with it.

The boxes then can be made into all sorts of different sizes and shapes of panels which would be determined at the design stage, which ones were most appropriate for your design and for your access to your house.

Ben: And when you're doing it traditionally, all of this happens on site, really. You're going to need covering and you're doing it there. Correct?

Barbara: Yes, exactly. So, it absolutely reduces the build time. So, when the panels are made in the factory, obviously you're paying for the labour time for that to happen, but once they come on site, you can put the walls of a three bedroom, two storey house up in three or four days. And then you've got to put the roof on and do all the other stuff you do with houses.

Ben: Let's bring in Dragons' Den for a moment because I saw you on there and thoroughly enjoyed that. This was one of the ideas that you brought in there. So, why, when you sold it to me and it seems very convincing, was it not something that they were keen to take up?

Barbara: Well, it's true they weren't keen to take it up, but they were very keen on the idea. I think it's the nature of Dragons' Den. It's a TV programme and it's there for entertainment. And to be quite frank, we are a design company and it's not really something you can invest in if you're a millionaire wanting to make more millions. You don't make millions out of a design company. You make millions out of being the pre-fabricator. We're not at that stage yet and really, we didn't expect the Dragons to invest.

We hoped that one of them might, philanthropically, give us the money we were after to help us on the next stage because it's all about education and awareness. But it's been really good for us, I have to say, and we have got quite a number of people who are interested in helping us on this journey, and particularly to get it into social housing.

What we're really about, what we're passionate about, is providing really good quality houses for ordinary people at ordinary prices. That's what you can do with these pre-fab panels.

Ben: One of the challenges that you came up against, it seemed to me it's just finance, both in insurance, in mortgages and things like that.

So, it's incredible to think of the grip that finance has really on construction. How are we ever going to move forwards?

Barbara: It was a bit misleading. I know Deborah Meaden raised that, and it's hard to answer it, but we've had a lot of contact with financiers, mortgage companies, money lenders – that sounds bad, doesn't it? And there are a lot of straw bale houses out there with mortgages and with insurance. They've all got insurance.

It's not really an issue. I think the issue is that nobody has done twenty-five houses at once on a building site and asked a mortgage company to do that.

Ben: But it's specialist still. You wouldn't be able to go to a big company. I know there are companies out there, because obviously straw bale buildings are getting built all the time.

Barbara: I don't think that's true. I've had several phone calls from people in the insurance industry since Dragons' Den who've said, 'what are they on about? We could do it.' And these are underwriters or people who know underwriters who can get us that business when we're ready.

The fact is that we haven't actually gone and specifically said, 'give us the mortgage, give us the insurance for this.' But there was a site that was going to be twenty-five houses, that the Ecology was going to finance half of them, and there was another company – I can't remember who it was now – that was going to do the other.

So, I don't really think that's an issue. It's something that is there and will happen when the time is right, and that means we have to have a development on the way.

Ben: What about from a slightly different perspective? Because I know self-builders who perhaps want to, deep down, build with straw bale, but they are deterred because of, let's say, something goes wrong half-way through the project and they have to resell. So, they don't even make it there, when their heart would probably say they should go. Anything to say to them?

Barbara: I think that this is a bit like the Walter Segal houses. Everybody laughed at his ideas and thought ticky-tacky, sort of, but actually, when you look at them now, thirty years on, they're selling for a premium. In the areas where they are, they sell for higher prices than the houses around them. And that's what these houses would do too. And mostly, people understand that because when they see them, they see the quality. They're simple and they're high quality houses.

Ben: What's it going to take to setup a factory for these panels? Is it possible in the UK, or is there not enough business to keep it going? What are the challenges?

Barbara: There is no challenge. At the moment, it's not cost-effective to setup a factory, but Ecococon will set up a factory tomorrow if there was the demand for it. And that's what they've always said and they're a very honourable bunch of people.

Ben: So, the process at the moment is just importing it. They do the work and it actually doesn't cost that much to get it over here?

Barbara: Yes. It's true. It sounds horrible, but the wages are a lot lower in Lithuania, diesel costs are a lot lower, tax is a lot lower, so all of those things mean that it is actually cost-effective. We can compete on an even footing with the masonry houses and the timber frame houses right now, but we're offering a better product. We're offering something that is much better thermally and much more durable.

Ben: And it feels better too. Every straw bale house that I've been in to just – I don't know. There's something very earthy about it. Obviously you've got the insulation value. How would you describe that?

Barbara: They're warm, they're cosy, they're peaceful and they just make you feel good. They're comfortable. It's something that is really hard to quantify in this world where everything has to be done by science, but if you talk to anybody who lives in a straw bale house or who's spent some time in one, they all say the same thing.

How can you put that in a box and say, 'this is what we're offering'? But that is the thing. They're not soulless and they're not too small, like people say about modern housing.

Ben: If we're starting out then, we think we want to build a straw bale house, what would you suggest? What are the first steps?

Barbara: The first thing you've got to do is get the land. I think that is the hardest part of anything, is finding the land.

We're absolutely constrained by our class system and our property ownership system. We should be building a thousand self-builds a year, like France is, and we can't because there's no land. So, joining in with other groups like community land trusts and co-housing and housing co-ops is probably going to be the way forward.

So, getting the land, and then what you need to do is think about what sort of design you want, which type of building you want and are you going to build it yourself or are you going to get somebody else to build it for you, and what's your budget?

Ben: What would you advise, or is it a case of budget is going to drive the fact that you have to do it yourself, like many self-builders can save money that way?

Barbara: I think it depends what you want. I think major house developers will go for pre-fab, self-builders will probably go for load bearing or hybrid, sometimes in-fill. In-fill is a bit more expensive.

But it's what your dreams are. People very, very often come and say, 'I've wanted to build my own house for years and I've always dreamed of a sort of hobbit house or I've dreamed of a little place in the country or I've dreamed of somewhere with a green roof.' And it's like trying to realise that. What we always say to people is try and imagine something that is enough but no more than that. I think that's quite a hard thing in this culture, is to be sufficient and not exaggerate things.

Ben: So, we've got the land now and we're getting it designed. I know that's a service that you provide, but is it something that any architect can go down a straw bale route? What skills do they need?

Barbara: I wouldn't say yet that any architect can do that because they're not taught how to do it.

Ben: What would they do wrong? I'm interested.

Barbara: [Chuckles] well, a lot of architects think that if you make the walls wide enough on their drawing, then that's a straw bale house. And that really just doesn't work.

Unfortunately, I've had quite a lot of drawings land on my desk as a consultant – I work often as a consultant to other architects – and you just have to make some changes. But by the time the plans have been drawn, they don't want to make any changes. So, it's very, very difficult to say things like, 'if you change this little sticking out feature that looks very nice in a picture but is actually difficult and expensive to build in practice, then that would improve the design.' And they just say, 'oh no, I'm not doing that.'

Ben: Yes. No more comment on architects. So, a simple form then. It sounds like you're alluding to that. And a lot of ecological design

tends to bring us back to that. Does it also add strength? So, if we're going the load bearing route, that that too will help us?

Barbara: Yes, definitely. Keep it simple, keep it small and design it so that you can add extensions on if you need them later. But just build for your needs as they are now. Don't build because you think you're going to have ten children and you only end up having a dog. It's crazy.

Ben: If we're sourcing the material then, how do we go about doing this, making sure that the bale is correct for the building? Because this is just a fundamental part, isn't it? Because this is a simple way of building, we need to get this bit right.

Barbara: Yes. And I have written a bale standard, and that's available on our website and in my book. But basically, you need bales that are dry, that are reasonably dense and they're uniform in shape. If you've got all of those in one bale, that's a good building bale.

Ben: But is it something that you go to a farmer and say, 'this is how I want it', or do you need some specialist way of creating it?

Barbara: No, it's not specialist. You go to a farmer and they'll always tell you, 'yes, I've got that, love' – they haven't always.

Ben: That's the first thing. Read the farmer.

Barbara: Yes. But you need to go and look at them yourself really, and pull out ten random bales, have a look at them, make sure they are what you want them to be.

A lot of farmers can supply that, but some can't. And especially the ones who've got the old baling machines, those aren't really up to the job. So, the ones we look for, quite often, are the ones that are baled by big contractors who've got modern machines and they're baling because they're transporting. So, that means they're going to have very dense bales because they're packing more straw into the bale and they're selling by weight instead of by the number of bales. That's a better option.

But some of them are baling stuff that's really too short, too brittle and has been chopped up by the harvester. We don't want that. We need long straw in the bales so that it's tying the bales well together.

Ben: And then when we're on site, maybe you could talk a little bit about foundations? Do we need any particular foundations for this or can it work with anything?

Barbara: Obviously, a straw bale house can have any type of foundation that you want, but what we would encourage is foundations that don't have any cement in them.

We're looking for a totally natural package. So, we like to do car tyre foundations, and we've just done the biggest building in the world with car tyre foundations here in London.

Ben: How does that work then? Take us through because it sounds like you've done that very recently.

Barbara: Yes. We're working in Tulse Hill, at the Holy Trinity Church, and we completed the foundations last year working with the community.

First of all, you have to find out what your ground conditions are. You must do that for any foundation. Then from that, we prefer to design with car tyres for communities because it can save them an enormous amount of money by doing the job themselves but taking time over it.

I think it took us, altogether, about four months to do the foundations for a building with a footprint of about four-hundred square meters. At the bottom, some of the tyres are tractor tyres because we've got point loads in this building.

It's a hybrid building so, there are posts but there's also load bearing straw. Under the posts, we're reaching loads of about eight-hundred kilonewtons per square metre. So, we've tested our tyre foundations to a thousand kilonewtons per square metre. They could do it just so easily. We could've done it to much greater loads, I'm sure.

So, this is literally ground-breaking work, but what it means is that we can now fill our tyres with pea shingle, because we tested it with pea shingle and with MOT Type 1, and the pea shingle is easier to use, much faster and much more user-friendly.

We had an estimate given to us for doing the same foundations with cement which was for a hundred-and-twenty-thousand pounds, and what it actually cost us including the pea shingle and the hiring of a digger and driver for a week, was twenty-thousand pounds. So, we've saved the church a hundred-thousand pounds by doing it this way, which is phenomenal. It's a make or break decision for many groups.

Ben: And I'm assuming not much can happen to these tyres as well? They're otherwise just going into landfill?

Barbara: Yes. We get them for free because you have to pay to get rid of them now. Most of them are underground and the bits that stick out above the ground are protected from UV light. Because that's the only thing that can degrade them. But equally, that takes a long time.

Ben: So, the tyres are filled up with the pea shingle. What layers have we got on top of that before we start using our straw?

Barbara: One of the guiding principles for building with straw is that it should be raised off the ground. So, that should be a minimum of three-hundred millimetres; we prefer four-hundred-and-fifty. So, you can do that partly by the tyres which we put in pillars rather than continuous and then on top of that, a structural box beam made of timber, with durable timber on the outside, and then the bales go on top of that.

Ben: When you're laying your bales, it's all about density. Are there other factors that we need to think about?

Barbara: Obviously, we don't have to think about anything at all except putting things together like Lego with the pre-fab panels. It's all done beforehand. When we're building for load bearing or in-fill and hybrid, we start off by getting the densest bales we can and then we compress them more for both load bearing and in-fill, so that we probably end up with a density of about a hundred to a hundred-and-twenty kilos per cubic metre by the time we've finished.

You actually can't make the bales compress more than that without taking them into a laboratory and using extremely expensive equipment. So, they couldn't be compressed more than that in normal conditions or even in extreme conditions. In weather, say, we had four foot of snow on the roof, that wouldn't affect the movement of the straw after they've been compressed.

Ben: What happens at window details and things like that?

Barbara: We have standard details for going around windows. We don't like to use any sorts of sticky tapes or anything because we don't believe that the glue will last as long as our houses, so there's no point.

We use materials that do have a long, long, long life. So, we'd have windows flush with a timber sub-frame, cover that with wood fibreboard which helps with any possible thermal bridging, over the top of that a lime plaster and then a linseed oil mastic seal between the plaster and the timber window.

Ben: And then going up, so load bearing if we're going on to the first floor. How would we deal with the floor structure and then obviously heading off again on a second layer?

Barbara: Load bearing houses are held together by structural ring beams. So, there'd be a baseplate at foundation level, a wall plate at first floor level, and a roof plate at eaves level, and the floors would be hung off those and ceilings hung off those as well. Those are sized depending on what openings you've got underneath and what loadings you've got above. But it's all really quite simple.

Ben: How is it all calculated though? Loads are obviously very important for this type of building.

Barbara: Yes, but when you're thinking about building physics, working out what loads are is really quite straightforward. It used to be done by just general builders. Experienced builders used to be able to do all those calculations themselves and the building inspector would look them over and say, 'yes, that's right. Off you go.' That's how I started.

Now, everything has to be signed off by an engineer, which I think is not because it needs to be, but because people are terrified of litigation and insurance claims. That's what it's all about. Fear.

Ben: What else do we need to think about then, on our structure?

Barbara: Weatherproofing is really important, and I'm saying weatherproofing not waterproofing because that's really important.

Generally, we would plaster outside with a lime plaster which is breathable, as the whole wall system must be breathable, and it also is very good at preventing water ingress. So, not straightaway; so the lime, when you apply it, has to be protected for a while before it builds up its ability to protect the building from water ingress

Lime is really fascinating as a subject because when it's carbonated, which takes two to three months on a wall, then when it gets wet, it absorbs moisture. It's not absorbing it as a porous material, it absorbs it at a molecular level and that absorption actually prevents further moisture coming in.

Other natural materials do that as well. Cedar shingles do that. You can put cedar shingles on a roof and you don't need any membrane underneath. The shingles themselves stop the water coming in when they get wet.

- Ben: On the inside, what have you got? Is it clay plaster?
- Barbara: Yes. Inside we would do either lime or clay plaster. We like to use clay plaster because it's very user friendly and you can often, if you're self-building, if you've got time, you can make your own plasters by digging it up from somewhere. Commercially, that can be more problematic, but you can buy clay plasters commercially now as well.
- Ben: Am I right in saying that moisture can get out of the building?
- Barbara: Yes. And that's a feature of our buildings. So, really, we talk about building healthy houses first, because that's what they are. Indoor air quality is really, really good because nothing toxic goes into the buildings at all, and the walls are totally breathable. So, all the paints, the plasters, the straw, everything is a breathable material. That means that there's a movement of moisture from inside to outside all the time because of the negative air pressure generated by habited houses.
- Ben: And what about does it penetrate in at all, or does the lime render just keep it at bay?
- Barbara: Moisture itself doesn't. We're talking about movement of vapour, not movement of moisture. Most people don't really understand what that means. It's not water, it's not steam, it's molecules that are so tiny you can't imagine them. So, it's not things moving through like you've got water or steam somehow that could condense. It's not like that. It's at a vapour level, at a molecular level.
- Unless you've got a house that's been standing empty for a while, the movement is always from inside to outside. That's why empty houses get damp whatever they're made of, because it starts coming the other way.
- Ben: And there's always something happening inside, isn't there? Cooking, baths and so forth.
- Barbara: Yes, living.
- Ben: So, you've done quite a few passivhauses or near passivhauses now. How are you feeling about that? I know you're obviously happy to do them but what would you like to do when you're building these? Do you like them nice and airtight?
- Barbara: I do like them airtight, yes. I think good details and high quality building is important. But I think it's all gone a bit mad and too far

and too techy. I am not an advocate of Passivhaus, I'm not an advocate of MVHR. I would like to be building to a level where we're just under needing MVHR, which means to around an airtightness of five air changes an hour.

We've actually done much better than that with our council houses in North Kesteven. We had two-point-six-two air changes an hour, and that was without any tapes, just using our standard details, without even the wood fibreboard on that we use now.

Ben: So, you're not sold on the extra energy that you can save? Because in some respects, having both the Passivhaus and the materials is a great mix.

Barbara: Yes, I know. A lot of people talk about it. It's very, very popular now. I think the extra energy isn't that great and I think some of the issues we have here are that most people are used to having gas central heating. Gas costs a quarter the price of electricity and these passivhauses are all run on electric. They don't have gas anything. So, the sorts of savings that we're able to make in the UK are not the same as the savings they make in a country like Germany where their electricity price is a lot lower.

So, it's very different for us and I have talked to people who are not really saving that much more. Yes, they don't have to pay much money on heating, but they're paying a lot more on cooking with electric and on the running of the MVHR.

Ben: How would you suggest then, someone wants to build their straw bale house, what level of understanding do they need to go to if they're not going to be doing it themselves?

Barbara: I think if they're not doing it themselves, they probably will be project managing it, and I think that they'll need a thorough overview of what the process is.

We actually run a series of one-day theoretical courses specifically designed for people who are expecting to embark on that process, who are looking for land, and we talk about the sorts of things you do on your website: what planning permission requires; what you have to do for building regs.; what other services you need, engineering, site surveys, bat surveys, that sort of thing.

What you can expect if you're building your own house or somebody's building it for you under your direction; going through the whole process; why thinking about the straw bale as the heart of the design is so important.

Details – so we do a design and details course focusing on window details and how to build the roof first, even if you're doing load bearing. Things like that.

And then a whole day just on plasters, on clay and on lime and why we should use them, what their properties are, where you can get them from, how you use them.

Ben: I'm always under the impression that straw bale is very inclusive, and you can volunteer. Correct me if I'm wrong here, but if we wanted some practical experience, that may be totally unnecessary, or just even to see it – I guess I'm lucky like that, that I go on to all sorts of sites. I don't touch anything, but that can help too.

Barbara: There are lots of volunteering opportunities and there are lots of how to learn properly straw bale building opportunities as well. As a school, we run courses in straw bale building, lime plastering, clay plastering and car tyre foundations, and sometimes carpentry, and people join the school and follow the curriculum. Occasionally, we run volunteer projects as well, but when we do that, we always make sure we've got a really experienced person who's leading the volunteers.

There are other projects that you can join. There are websites you can look at where you can find volunteering opportunities where you may get good teaching, or you may just all muck in and have a go and do it, because it is simple and straightforward. But if you do it like that, you don't always get a high quality job. But you don't always need to if you're just building a shed in the garden, having a go or practicing.

Ben: It's been lovely to catch up with you. Any final thoughts?

Barbara: Well, you know, I'm reaching the end of my career. I'm getting on a bit now. But I would really, really like to see mass housing in straw and I'd really like to see the little tiny buildings that we do, the garden buildings, take off. Because that really is the way that we're going to keep the school going, by finding an income that can make it possible for us to offer bursaries to people. Because we're in the field of private education at the moment and I'd like to see accreditation for our courses.

Ben: Good luck, Barbara. Thank you very much for your dutiful service.

Barbara: Thanks Ben. Great to talk to you.