Openings in Load-bearing designs

We need to consider the design of window and door frames and openings for several reasons; to be sure that they are structurally sound, both in terms of being strong enough to withstand the pressure of bales being wedged in beside, above and below them, and to help take the loads above them if necessary. We also need to ensure they are airtight and don't let in draughts, make sure they are the right size and in the right place to maximise solar gain without overheating, and allow enough daylight into our homes and offices. All window and door openings in load-bearing houses must have some way of supporting the weight of the bales, floors and roof above them. Owing to the flexibility of straw, the use of concrete or steel lintels is inappropriate and their weight in fact would create problems – as they sit on only a small bearing surface they would compress the straw too much in a small area. Weight (load) needs to be spread over as wide a surface area as possible.

Structural box frames

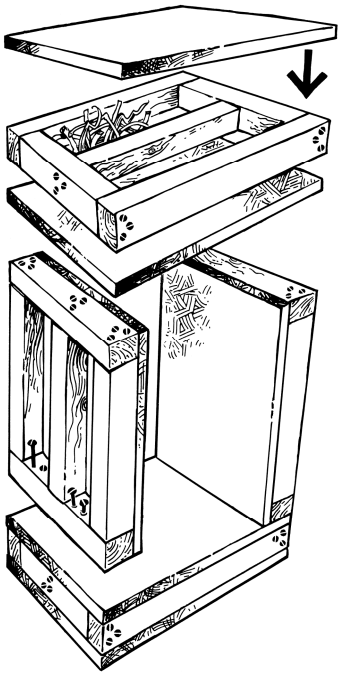
A simple way of dealing with openings is to make a structural box frame into which the actual window frame or door frame is fixed. The design of these box frames must take into account the fact that the straw walls will settle under the weight of the floors and roof above. It is impossible to know exactly how much settlement will occur, as it depends on the density of the bales and the amount of loading applied to them, although it's possible to be pretty accurate if using construction grade bales all from the same source. 75mm (3") is usually sufficient, and the frames are therefore built to be 75mm less than the height of a whole number of bales.

Except in unusual circumstances, structural frames should be multiples of bale dimensions, so external dimensions of the frame could be anything from half a bale to three bales in width and any number of bale heights minus 75mm (3") to allow for compression or settlement.

Frames are pinned into the bales with hazel, through the base during construction, and through the side once settlement has finished. Door frames would not have the base box for a window. Instead, the sides of the frame would stand directly on the foundation and be fixed in position with bolts into the foundation or attached securely to the timber base plate..

The actual sizes of timber used, particularly for the top of the box, will depend on what weight the timber has to carry and over what span. This will be affected by the design of the wall plate above it, which may be able to partially act as a lintel for the window or door. In general, an opening of over 900mm (3') wide will require the box above it to include timber of at least 225mm high x 50mm (9" x 2") to make it strong enough to prevent the box from bending as it carries weight from above across the gap.

Weatherproofing details around windows and doors are very important. The join between the box frame and straw, and between the window frame and box, must be more than adequately covered with plaster and/or timber to prevent draughts and the possibility of rain penetration. Rather than using expanded metal lathing (a twentieth-century solution) we would use hessian, reed mat or wood fibre board tacked securely to any timber, which can be plastered over to make a weather-tight join between straw and timber.



In some cases, the box frame can be attached to the wall plate, using that as a lintel instead of the box having its own top. In such cases, the settlement gap would be left at the bottom of the frame, not the top. However, this isn't a good option if the roof overhang would obscure any light coming in from the top of the window.

Fixing posts

Fixing posts are much more common than structural boxes for the attachment of windows and doors. These use less timber and are easier to work with on larger buildings, as well as providing location points for the wall plate above once it is placed. They are made from two pieces of 100mm x 50mm timber (4" x 2") nailed together, which is stronger and cheaper than using a 100mm x 100mm (4" x 4") post. They are firmly attached to the base plate, one either side of each opening, central to the bale wall, bounded on all sides by cross noggins for stability and strength, and left long as they will eventually project through holes in the wall plate. It is essential that these fixing posts are well braced to prevent any distortion of them during building, as bales will be pressed up against them with quite a bit of force. They need to remain vertical and central. The distance between posts would be the width of the actual window or door plus 5mm (¼") to allow for fitting, plus the thickness of the lining timbers, usually two of 50mm (2").

Windows have a timber sill housed horizontally into the posts, 200mm x 50mm (8" x 2"), usually three bales high but this varies according to design. Bales are laid first, pre-compressed manually with straps, and then the sill is fitted; so the height of the sill is calculated based on the number of bales below and the amount of compression to be achieved.

A similar timber is housed into the posts as a header, 300mm x 50-75mm (12" x 2-3"), and this is calculated to be above the sill by the height of the actual window plus 5mm (¼") to allow for fitting.

The header must be of sufficient size to take the weight of bales above it without distorting, so for openings larger than 900mm (3') it will need to be increased to 225mm high (9"). Instead of using one solid piece, this would be two pieces housed vertically into the sides of the posts instead of the face, with a board above of 300mm x 50mm (12" x 2”) to support the bales, and below a lining timber. The space between these would be filled with tightly packed straw for insulation.

Doors have a header similar to that for windows, or the wall plate itself acts as the header. If this is the case, don’t forget about the compression gap for settlement.

Framework methods

In framework methods, windows and doors are designed into the framing, and usually have upright posts either side of them that run from the base plate to the beam above. These posts can be of various designs. A post and beam style would use solid timber and a compressive frame would use posts the design of which was compatible with the method of lowering the frame once all the bales were in position. The framing sill is fixed after the straw below it has been placed and compressed manually (see above).

With a framework, the dimensions of windows and doors do not need to be multiples of bale lengths, but the design should ensure that the gap between one fixed post and the next does relate to full or half-bale lengths, to make the bale installation easier.

If there is a bale between the top of the window and the beam above, framing must be designed to carry the full width of the bale, and for compressive frame methods allowance should be made for settlement of the top beam or wall plate on to the straw.

Weather protection

The detailing around windows in particular is very important, as the junction between the window, sill and plaster can take a lot of rain and so you need to be especially careful to make sure this is done very well.