

Footprint Facts and Figures

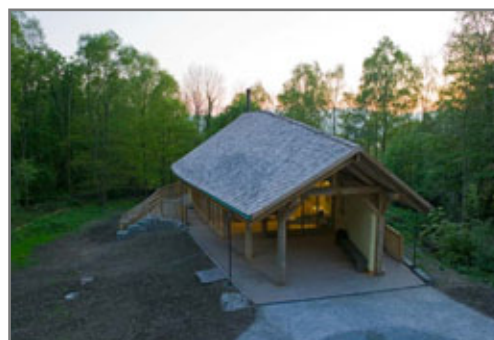
Footprint Building Factsheet

The Vision

In July 2007 the National Trust's first straw bale building will be officially opened at St Catherine's near Windermere in the Lake District National Park. The new building, known as **the Footprint** is also the first of this type in this part of the world. Now up and running it provides a beautiful and inspirational indoor base for groups visiting St Catherine's on an educational trip, and for other users. Apart from these firsts, the Footprint is also innovative because of the nature of the building's design, the other materials used and the approach taken to getting it built.



Many of the building materials are from sustainable, renewable resources, or from recycled materials. To cut down on transport these were as locally sourced as possible. The building's design makes good use of natural light and has excellent insulation, thereby reducing electricity and heating needs. At the end of the building's life many of the materials will naturally biodegrade or can be recycled. It will leave a very small ecological footprint.



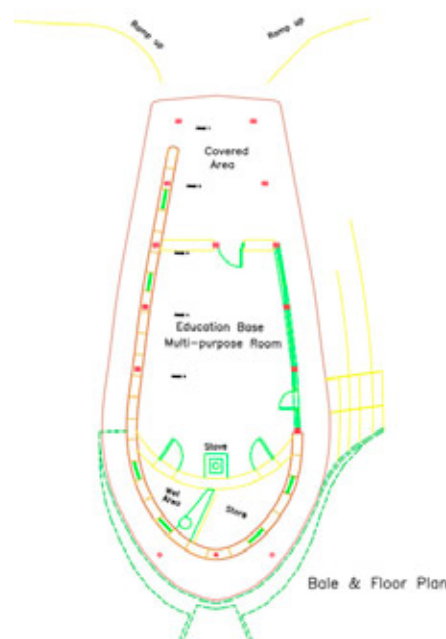
During construction, every opportunity was taken to include and engage people with its progress. Some building was undertaken by groups on courses, working as trainees. The straw walls, car tyre foundations, some of the cob and roof and most of the plastering was completed this way. National Trust staff and hundreds of volunteers got involved practically too, working on the walls, producing cob bricks and plastering and painting. Alongside, other aspects of the project were also undertaken by volunteers, who contributed to documentation, administration and education development. Site visits, open evenings and talks were arranged for visitors and members of the local community and a schools project ran with 5 local classes from 4 different schools.

Building something new gave the Trust the opportunity to think imaginatively about what was wanted, and as well as being visually very appealing the Footprint now stands as a showcase for the wider benefits that can be achieved if sustainability and social aims are integrated into the project planning process from the outset.

The Design

The Footprint is located in a small meadow in front of the existing buildings at St Catherine's. It is a hybrid construction, meaning the roof is supported by a mix of load bearing walls and framing. The frame and two portals in the interior also brace the building. Inside it consists of a single open space of about **105m²** with a small store and tea making area partitioned off, and a small covered activity area and a timber walkway around the outside of the building.

It is a simple but unusual shape, almost like a snow shoe footprint, which is almost elliptical at one end with gently curved walls. The roof is pitched at 35° to reflect the pitch of the existing building and it is extended at one end; there is quite a large overhang on all sides for protection, but the western side faces the prevailing weather, hence the peak. The overhang screens direct sunlight in the summer. The total size of the building is around **220m²**.



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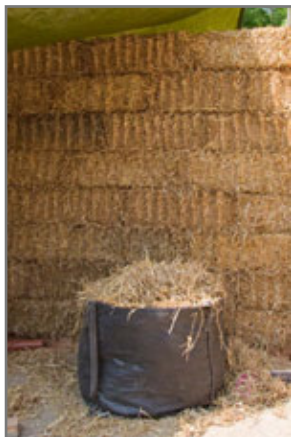
The south facing side is glazed, which allows the use of natural light in the inside, and gives the feeling of the building being within the meadow and not shut off from it. There is one door and the windows maximise solar gain and allow ventilation. The sense of being part of the site is further emphasised with steps from the covered walkway, which curves around the building in line with the roof overhang. The outside walkways and floors minimise erosion.



The northern side is one long wall with a single window, which extends to provide a sheltered wall to the small covered activity area. On the eastern end there is a straight wall with one door, leading out to the covered area.

The western end is beautifully curved, with four small windows. The site's slope meant a banked platform for the building was created on this side which allows the building to sit slightly into the ground at the eastern end.

The Materials and Resources Used **Straw Bale Walls**



Some 360 standard wheat straw bales were used in the Footprint (many resized to fit our building during construction). These originally came from a farm in Yorkshire, harvested in 2005. This might sound like a lot of "straw miles", given that it grows nearer to Windermere, but straw for construction needs to be as strong, straight and densely baled as possible. It also needs to be consistent in texture and in size, and be dry, with no hint of mould or mildew. Straw from the east of England grows on even, flatter land than in the west and this tends to make it more consistent in texture and strength; in 2005 it grew in drier conditions which also helped.

The use of straw bales in building has been widespread in Canada and the USA for over a century and has been increasing in the UK and in Europe over the last two decades. The main environmental advantages of straw building are:

- **Sustainability:** Straw is an annually renewable natural material and approximately four million tonnes are surplus to requirements in the UK alone.
- **Biogradability:** At the end of the building's life, the straw will degrade naturally, leaving no trace.
- **CO² emissions:** It is estimated that over 50% of all greenhouse gases are produced by the construction industry and its associated transport. Straw has absorbed and stored CO² and straw bales don't need to be fired like bricks and don't need cement.
- **Insulation properties:** with almost 3x the insulation value of standard building materials, straw is extremely efficient at reducing the heating demands of a building. Its use means there is no need for environmentally damaging insulation materials in the walls. This also means that the soundproofing is excellent too.

Additionally, straw can be used to make a very conventional building or it can easily accommodate curves and bends in the walls, deep alcoves and other features internally that give a building character and charm. In the Footprint there are some alcoves in the kitchen and on the wall of the covered activity area.

Rendered straw walls are not any more flammable than conventional walls; in fact recent tests are showing that the burn time of straw walls is less than that of bricks. Nor is it going to attract vermin; straw is not a food source for mice, rats or any other small animals, although they really like holes in straw, which is why it is important for the walls to be properly rendered and maintained. Straw walled buildings are also very durable; there are examples in parts of the US (with a colder climate to the Lake District) of buildings going strong even after 100 years when well maintained.

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To build with straw it has to be kept dry; no moisture can penetrate during construction. This means that it needed to be carefully stored and when the walls were going up a canopy was erected to keep off the rain from above and from the sides, and from winds that might blow in moisture even if it's not raining. At the end of each day the walls were carefully covered and protected so the sides were kept dry until properly rendered.



We were extremely fortunate with the weather in 2006; apart from a few wet days early on, the straw walls saw mostly hot and dry conditions during their settlement period, although nothing was left to chance and they were carefully covered at the end of each day. Four full weeks of straw wall construction took place, all undertaken as training courses. The render, applied in August, is 3 coats of lime plaster externally and 2 coats of clay plaster internally.

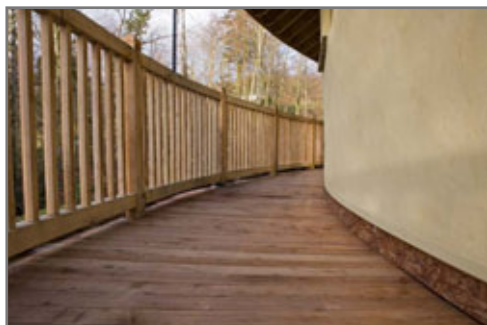
Timber



As with straw, the use of domestic, mostly local, timber in the Footprint means we are using materials that are renewable. It is all from sustainable National Trust woodlands in the Lake District, which are managed for long term timber production through careful planting, whilst protecting their biodiversity and amenity value.



The roof is of triple lap oak shakes, with a breathable felt membrane. The 12,000 shakes are from sustainable sources in the south west; even though it requires further transportation ("shingle miles") and thus higher CO₂ emissions. SW oak generally has a stronger, straighter, grain than local "twisty" oak which doesn't produce the same neat split, and means that fewer trees were needed for supply.



Green oak has been used for the frame of the building and the suspended interior floor and skirtings are from local beech. The exterior walkway, steps and flooring in the covered activity and the bridge from the car park area are from local larch. The balustrade on the walkway is from local oak. Three dozen mature trees were used in total on the building; the beech and larch mostly from felling; the oak from trees that came down near Coniston in the gales of January 2005. The careful choice of timber has minimised the need for chemical preservatives.

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Other Material Facts

- Internally a curved cob (mix of clay and straw) wall separates off the main room from the small kitchen and store. This will naturally draw in excess air borne moisture when levels are high, aiding humidity control. Three types of cob are seen; initially the cob was a straightforward mix of clay from a local brickworks and soil cleared from the site. When this got too high for further safe construction, emphasis moved to the manufacture of bricks (on site by hand using purpose made forms then air drying the bricks on racks). This was slow going and although over 120 different volunteers came and got their hands dirty on work parties making 1500 bricks we couldn't produce enough quickly enough, so ended up buying 600 bricks in. The supplier is down in Devon and these bricks are very red and bigger compared to our Cumbrian brown earth. The wall was finished by National Trust masons and in volume we have 22.5 m3 of cob!
- The 41 foundation pillars for the suspended floor in the Footprint are of recycled car and tractor tyres, infilled with rammed, reused subsoil and clay mix into footings. Their construction was very labour intensive and was undertaken as part of the first training course. Over 120 car tyres and a tractor tyre were reused this way; the cob wall itself sits on a curve of 17 rammed earth tyres.



•Pilkington K Glass is used for the windows and glass walls. It has what is called a "low emissivity" coating on the surface that faces into the air gap of double glazing. The heat absorbed by the coated glass is inhibited from radiating across the air gap and then again from the outer pane to the colder outside. Instead the heat is reflected back into the room by the coatings.

•There is only the need for a single heat source and a highly efficient stove has been installed which will use on-site coppiced timber. By positioning this next to the cob wall, the wall will also act to take up thermal mass and emit this at the colder part of the day.

•The stone for the battered base is a mix of slate reused from the demolition of an on-site garage, and other, unsawn stone sourced locally. The amount of stone work needed was been reduced by earth banking.

•The floor voids are insulated using local sheep's wool, around 30 bales, with a corresponding amount of locally produced Thermafleece in the roof voids.



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Construction Facts

- The Footprint was built through a Partnership arrangement under a negotiated tender with Lambert-Gill from Carlisle as the Principal Contractor and Amazon Nails from Todmorden as the Training Enterprise who undertook the green building aspects of construction.
- The building was designed by Paul Crosby Architects in Kendal who produced the original sketch designs, then developed and detailed in house by the National Trust's Building Department in Grasmere.
- The site was cleared at the end of March 2006 and the contractors mostly finished their work at the end of October. It was fit for use in February 2007.
- The car tyre foundations, the straw walls, most of the lime and the entire clay plastering were constructed by unskilled participants on training courses. Over 140 paying participants and staff on National Trust training places lent a hand and learnt these new skills. 325 labour days were put in on training events.
- Over 120 different people ranging from youth groups, families, friends, National Park and National Trust staff and other volunteers contributed to the construction of the cob wall alone. A further 60 or so volunteers helped with painting, lent a hand with roofing or other practical work, or with administration, education work, catering, filming, photography, website creation and the production of resources. This put in around 125 days hands-on on construction and 230 or so days on other aspects of the Project.
- In total over 450 labour days were put in by volunteers and trainees on the building
- During construction there were 7 open evenings for members of the public which were advertised locally; 15 special interest group visits and staff gave 6 talks offsite to a range of groups. The construction featured in Cumbria Green Building week.
- Local BBC Radio, Radio Cumbria provided sound recording equipment during construction and a radio blog by the Community Education Officer was broadcast every few weeks.
- A time-lapse camera kept a record of the construction. Fixed in an upstairs window of the existing buildings, it took a photograph of the site every 5 minutes during daylight in the week. Over 43,000 images were taken!
- Over 2600 digital photographs were taken throughout construction and the project has its own website www.strawfootprint.org
- Alongside all this a local schools art and sustainability project began, which will run for 3 years. Phase I focused on the materials in the building and currently there are 4 different schools and 127 pupils in total involved in the project.
- Building Cost per sq m...£1,750 approx; Building and landscaping cost @**£277,500** –final account due end 2007.
- The Footprint Project has been made possible by a bequest from the estate of Enid Rowell, grant aid from the Lake District National Park Sustainable Development Fund, a small income from courses and a number of small donations from local business and groups.



Project Team

Project Sponsor – John Darlington, Area Manager South Lakes National Trust

Project Manager – Tim Ashberry, Property Manager Eastern Valleys National Trust

Project Supervisor & Detailed Design – Chris Shepard Senior Building Surveyor National Trust

Project Development and Learning – Gareth Thomas Community Learning Officer Eastern Valleys National Trust

Project Co-ordinator – Alison Platt, AP Projects

Regional Curator – Sarah Woodcock, National Trust

Environmental Advisors – Rob Jarman & Denise Loten, National Trust

Principal Contractors – Lambert-Gill, Carlisle

Training Facilitators – Amazon Nails (consultants & straw bale construction), Todmorden

Architect (Sketch Design) – Paul Crosby, Kendal

Planning Supervisor – David Watson, BCA Services Liverpool

Quantity Surveyor – Ian Haymes, Baker Mallet Whitehaven

Structural Engineer (Oak Frame) – Deb Turnbull, Quercus Malvern

Structural Engineer (Sub-Structure) – Richmondshire District Council