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Abstract

In 2008 embodied energy in construction accounted for 17% of carbon emissions in the UK and is set to rise as a proportion of total emissions. [1] The use ‘bio-based’ materials may be an important way to reduce the embodied energy of construction. A series of case studies are presented using hemp lime, timber and strawbale construction. Typically problems have occurred due to lack of design guidance, inexperience and a lack of early contractor involvement. A collaborative culture and approach has overcome these problems and ensured that lessons learnt are taken through to future projects.

Keywords: collaboration; embodied energy; bio-based materials; low-rise buildings.

1 Introduction

The ‘Paris Agreement’ set out a plan to avoid dangerous climate change by limiting global warming to well below 2°C. To achieve this target global emissions will need to peak by 2020, be halved by 2050, and go to below zero well before 2100. The later action is taken, the earlier we will need to reduce emissions to below zero, i.e. we need to store more carbon than we emit. Some emission scenarios would suggest that we would need to become ‘carbon negative’ by 2065 [2].

Perhaps the simplest method of carbon capture and storage technology is through the use of ‘bio-based’ materials including crop ‘by-products’ such as straw, hemp shiv, timber, sheepswool etc. There are no generally accepted codes of practice in the UK for their use. The long term performance of these materials in the UK has not been fully studied.

A series of small case studies are presented which show how buildings have been created which reduce the embodied energy in construction through the use of a variety of ‘bio-based’ materials. The ethos throughout all the projects was to use local and sustainable resources where possible, to help ensure a vibrant and sustainable local economy. As such the success of these projects is highly dependent on the degree of collaboration between client, design team and contractors.

2 The Sites

The sites are all located close to each other on the northern side of Loch Tay in Perthshire. Weather conditions may be considered slightly worse than the UK average.

2.1 The Straw Bale House, Tombreck

The client managed the project build and carried out many of the tasks themselves with the help of
‘volunteer labour’. Strawbale builds are weather dependent starting in spring, with the final lime based render coat being applied in September before the first frosts. A portal frame timber structure was chosen, that was pre-erected to protect the straw below. Pre-erecting the roof meant access was more difficult to place the straw in the awkward triangular shaped areas. This caused some gaps to open up which needed to be locally repacked and repaired.

The project won the 2012 Murray Armor Self Builder of the Year award. Long term (8 years on) the performance of the straw is dry, and the building provides a comfortable home.

2.2 The Lime Hemp House, Tombreck

Combining hemp shiv with lime, means that it can be used as a ‘mass material’ that has desirable thermal qualities and reduces the risk of air leakage. Due to the lime binder the material does not settle over time. Racking boards were required to provide stability, these were not sufficiently dimensionally stable for the application of the hemp lime mix. Some of the boarding had to be removed and redesigned to allow for the method of construction. The performance of the building is considered good by the owners.

2.3 The Big Shed, Tombreck

‘Designed and built to extend an ongoing hill farm regeneration project, there have been multiple aims ... Not only have the most sustainable materials and methods compatible with such a building been used but, also, the local community has been engaged in its construction as far as possible’

2.4 Lime Hemp House, Rynachulig

This project well illustrates the flexibility of Lime Hemp whereby a myriad of structural and architectural forms may be accommodated without sacrificing building performance.

2.5 Croft House, Tombreck

This project has just started construction. Here the project team incorporated ‘Hempcrete UK’ the proposed lime hemp contractor from the outset, who was able to advise on the suitability of the details for construction.

3 Conclusions

The use of Bio-based materials for construction is a good method of providing quality low-rise buildings that reduce embodied energy. Working in established teams may ensure knowledge is transferred across projects. Detailing is important to ensure good air-tightness. Development of a code of practice will enable more efficient use of materials especially with regards racking resistance.

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5 References
