Client Report :

Environmental profile of a timber frame house - an initial study

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Prepared for :

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Executive Summary

This report has been prepared for the Forestry Commission for work carried out under BRE proposal number 103606, commissioned by Mr R Selmes.

Designers and specifiers are increasingly interested in the environmental performance of materials and components as they seek to produce “green” buildings. To satisfy the need for such information, the timber frame industry, with its growing market will benefit from having their processes independently assessed and analysed. The BRE methodology, an accepted, established method amongst supply chain companies and construction professionals, has been used to produce the environmental profile of a timber frame house. The environmental profile was determined using the data supplied by the timber frame manufacturer who participated in the project and also the environmental profiles from a previous project profiling UK forestry, sawmilling and panel production.

This study has produced an initial indicative environmental profile on the manufacture of a typical timber frame house which showed:

- The impacts of forestry were beneficial, as a result of the carbon sequestered by timber growing in the forest, and dominated the climate change impact.
- Similar contributions to acid deposition and human toxicity to air were made by each of the impact sources; raw materials, ancillaries and packaging, fuels and transport.
- Fossil fuel depletion and transport pollution and congestion impact categories were dominated by the transportation of raw materials to site, principally due to the long distances travelled to deliver the sawn timber from Canada and Scandinavia.
- The fuels and energy used in producing the timber frame were low, mainly comprising electricity and a small amount of diesel, which accounted for around 7% of the impacts of fossil fuel depletion and 8% of the eutrophication with 15% contribution to acid deposition.
- Mineral extraction impacts for the timber frame house came from the raw materials, mainly the resins used to make the board materials, and the ancillary materials; the adhesive, packaging and extraction of metals.

The benefits of using timber in construction have been shown by the negative (beneficial) climate change impact resulting from the carbon sequestered by the growing trees in the forest. Minimising the transportation of materials by using local sourcing would reduce the impacts of fossil fuel depletion, acid deposition, human toxicity to air and eutrophication.

This study has produced an initial indicative environmental profile however, data from one manufacturer only has been used and the scope does not include any environmental impacts associated with the use of the timber frame house or its disposal. Evaluation of these impacts should be undertaken to allow a complete life cycle assessment of the timber frame house. Furthermore, if average data from several manufacturers are used, this information could be incorporated into the BRE database and made more readily available to specifiers and users.

The environmental profile for one timber frame house is presented as a concise environmental profile with numerical and graphical information and conclusions in Annex 1 of this report.

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Introduction

This report has been prepared for the Forestry Commission for work carried out under BRE proposal number 103606, commissioned by Mr R Selmes.

Interest in the environmental performance of materials and components has increased amongst designers and specifiers as they seek to produce “green” buildings. In order to satisfy their request for such information, the timber frame industry, which is currently growing its market share would benefit from having their processes independently assessed and analysed. The data supplied is processed according to an accepted, established method to produce an environmental profile.

This study has produced an initial indicative environmental profile on the manufacture of a typical timber frame house. It has used the BRE methodology that was developed to identify and assess the life cycle effect of building materials and components and which has gained widespread acceptance by supply chain companies and construction professionals.

The approach has already been used to determine the environmental profiles of UK forestry, sawmilling and panel production and has produced positive outcomes that help provide the robust underpinning required to demonstrate timber’s advantages as a construction material. This new study will produce an indicative assessment of the environmental impacts of the next processing stage required to produce a timber frame housing from sawn timber and panel products. The outcomes of the study will enable an initial determination of how the timber frame manufacturing process influences the environmental impacts of UK timber in construction.

Description of the project

The Building Research Establishment has developed a methodology for identifying and assessing the environmental impacts of building materials and components over their life cycle. The method incorporates information from raw material extraction, through processing, construction, the use phase and eventually disposal. Data collected and stored within a database allows comparisons to be made between the relative impacts of different components and designs enabling informed choices between alternative options to be made by specifiers and clients.

This project provides an initial assessment of the manufacture of timber frame housing, building on a recently completed three-year project assessing the environmental impact of the UK forestry, sawmilling and panel production industries. Profiles for each of these industrial sectors were produced and can be used as the basis for the production of profiles for downstream wood-based products. The profiles for the sawmills and panel mills form the foundation for further studies on wood-based products produced further along the supply chain and these were used to carry out the initial assessment of the manufacture of timber frame housing.

Liaison with and support from a timber frame housing manufacturer was sought and provided the data needed to generate the environmental profile.

Objectives

The principal objective of this project was to produce an initial indicative environmental profile for the manufacture of timber frame housing. The results from the previous more detailed project on the environmental assessment of the UK forestry, sawmilling and panel production industries were used as a basis for the assessment.

The following tasks were undertaken:

- A visit was arranged with a timber frame housing manufacturer to map their manufacturing processes and select an appropriate typical timber frame house for assessment. The structure of the timber frame house was a 3-storey semi-detached block.

- Data from their process was collected for analyses and processed according to the developed BRE methodology.
- An environmental profile for the 3-storey house was generated and an environmental profile summary for the timber frame house was prepared.

The findings and conclusions drawn from this study are reported and the environmental profile summary for the timber frame house is attached in Annex 1.

Findings

The most common design of timber frame house sold by the manufacturer was described as a 3-storey semi-detached block. This included two main floors in the house and rooms in the roof space.

The wall studs, flooring joists and roof trusses of the house were constructed of imported whitewood from Canada and Scandinavia, whilst the particleboard and oriented strand boards were supplied from within the United Kingdom. The ancillary and packaging materials used were also sourced from within the United Kingdom.

As full an assessment as possible was carried out in the study. However, some of the data provided by the manufacturer could not be incorporated at present as information on, for example, the production of the organic based preservative used was not available for inclusion in this study. Also, the environmental impacts of UK sawn timber were used in the profiles as detailed information on the processes involved in producing such timber in foreign countries are not currently available.

The climate change impact was predominantly the result of the raw materials used in the manufacturing of the house. The impacts of forestry were evident in the climate change impact with its negative value a result of the carbon sequestered by timber growing in the forest. Each of the impact sources; raw materials, ancillaries and packaging, fuels and transport, contributed a similar amount to acid deposition and human toxicity to air.

The fossil fuel depletion and transport pollution and congestion impact categories were dominated by the transportation of raw materials to site. The main reasons for this were the long distances travelled to deliver the sawn timber from Canada and Scandinavia and the board material, also delivered from UK sites located long distances away by road. The emissions associated with transporting materials to site were responsible for around 20% of the acid deposition and human toxicity to air, and 50% of the eutrophication. Transport emissions also contributed 75% of fossil fuel depletion. The fuels and energy used in producing the timber frame were low, mainly comprising electricity and a small amount of diesel, these accounted for around 7% of the impacts of fossil fuel depletion and 8% of the eutrophication with 15% contribution to acid deposition.

The mineral extraction impacts for the timber frame house came from the raw materials, principally the resins used to make the board materials, and the ancillary materials; the adhesive, packaging and extraction of metals.

Conclusion and recommendations

- The production of the timber frame house required little energy and fuel consumption thus the climate change impact remained a negative value dominated by the beneficial carbon sequestration in the forestry stage of the process.

- The predominant impact on the environmental profile comes from transportation which was principally due to the transportation of the raw materials. These constituted 99.5% of all transportation impacts with the largest contributions due to the long distances travelled to bring in sawn timber from Canada, Finland and Sweden.

- Impacts that showed pollution to the air; acid deposition and human toxicity to air, were attributable to all impact sources; from raw materials to transport, and would benefit from improvements from each of these sources.

The environmental profile of the timber frame house illustrates the benefits of using timber in construction from the beneficial effect seen in the climate change impact. This resulted from the negative (beneficial) climate change impact from the carbon sequestered by the growing trees in the forest.

Fossil fuel depletion, acid deposition, human toxicity to air and eutrophication impacts would be reduced by lowering the transportation of the raw materials. More local sourcing of the timber materials would see marked improvements in these transportation impacts.

The scope of this study does not include any environmental impacts associated with the use of the timber frame house or its disposal. It should be noted that these impacts, for example arising from the repair, maintenance and replacement of timber components or the release of carbon back into the atmosphere when timber is landfilled or burnt at the end of life can be significant. Evaluation of these impacts should be undertaken to allow a complete life cycle assessment of the timber frame house.

This study has also been carried out on the data from one manufacturer only. It is recommended that further manufacturers' data be studied to ensure that there is no bias in the current profile. Furthermore, if average data from several manufacturers are used, this information could be incorporated into the BRE database and made more readily available to specifiers and users.

References

1. Howard N, Edwards S and Anderson J, 1999 BRE methodology for environmental profiles of construction materials, components and buildings, CRC Ltd.

2. Mundy J, Thorpe W, Bonfield P, Hillier W and Murphy R, 2000 Environmental Assessment of UK forestry, sawmilling and panel production, Final report.

Annex 1 Environmental profile and assessment - Profile for One timber frame house