Trussed Rafters

Key Information

General Process Description	Softwood spruce trussed rafter – 8m span. Fink truss for a roof with a 35° pitch.
Reference Flow/Declared Unit	Softwood trussed rafter with an 8m span. Galvanised steel connector plates also included.
Reference Year	2013

Methodological Approach

This generic dataset has been developed with reference to CEN/TR 15941:2010 *Environmental product declarations — Methodology for selection and use of generic data* and has made use of data from existing databases and EPD, compensated with data from UK industry and national statistics for the specific situation related to UK consumption of timber products. With regard to methodology, the datasets are in line with the core Product Category Rules given in EN 15804+A1: 2013 *Environmental product declarations — Core rules for the product category of construction products*, and further detailed in FprEN 16485:2013 *Round and sawn timber — Environmental Product Declarations — Product category rules for wood and wood-based products for use in construction* and the draft EN 16449, *Wood and wood-based products — Calculation of sequestration of atmospheric carbon dioxide*.

The generic dataset is intended for use as upstream data for UK consumed timber products within EPDs and building level LCA assessments to EN 15978:2011 *Assessment of environmental performance of buildings — Calculation method.*

Modelling & Assumptions

Trussed rafters are structural systems designed to support the roof of a building and consist of timber and steel connector plates. A wide range of truss designs, spans and roof pitches are available, with each trussed rafter system chosen to suit the strength and design requirements of the building in question.

In this study, the modelled system is a fink truss with an 8m span and a 35° roof pitch. The fink truss is among the most popular truss design and consists of a long horizontal "tie beam", two rafter beams that form the top of the roof and four web beams that are angled between the tie beam and rafter beams to give the system a high level of rigidity and strength. Beams are held together by galvanised steel connector plates.

The tie beam is 8m long, 97 mm deep and 35mm wide. Rafter beams are 4.88 m long, 97 mm deep and 35 mm wide. Long web beams (running from the tie beam to the point of the roof are 3.07 m long, 72 mm deep and 35 mm wide, while the short web beams (running to the middle of the rafter beams) are 1.5 m long, 72 mm deep and 3 5mm wide.

Seven galvanised steel connector plates are required for the truss. These have been modelled using information related to gang-nail connector plates from DWB Group [DWB 2013]. The overall mass of the fink truss system is 40.3 kg, with timber accounting for 39.0 kg of this and connector plates accounting for 1.3kg.

The dataset is designed to provide an indicative value for a commonly used timber trussed rafter design and can therefore be used as a first approximation of the impact of similar rafter systems. Users wishing to understand the impact of significantly different trussed rafter designs may wish to create their own results through scaling of the individual datasets created as part of this project (kiln dried softwood, galvanised steel for connector plates).

The kiln-dried sawn spruce used in the open panel system is modelled using the same assumptions about forestry practices, sawmilling, kiln drying, transport, end-of-life and the country of origin of the wood as those in the “Kiln dried sawn softwood” dataset also produced as part of this project [Wood First 2014].

Connector plates are modelled as being manufactured from hot dip galvanised steel sheets using data from the GaBi life cycle database developed by PE International [PE International 2013]. Transport of the connector plates to the building site is modelled as having an average haul of 139 km based upon Department for Transport statistics for steel sheets [DfT 2005].

The end-of-life of the connector plates is also modelled with the same three indicative scenarios used for timber: 100% recycling, 100% incineration with energy recovery and 100% landfill. The benefit of steel recycling and the burdens of remelting have been modelled based on the “value of scrap” approach used by the World Steel Association [worldsteel 2011]. As steel does not burn in waste to energy incinerators, no impacts associated with this option have been modelled. Steel in landfill has been modelled using models for inert material in landfill.

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Environmental Parameters Derived from the LCA

Production & Distribution (Cradle-to-Site)

Parameters describing environmental impacts	Units	Production *(A1-A3)*	Distribution and Installation *(A4-A5)*
Global Warming Potential	kg CO2 eq.	-51.3	1.61
Ozone Depletion Potential	kg CFC11 eq.	2.89E-10	5.46E-12
Acidification Potential	kg SO2 eq.	0.0611	0.0156
Eutrophication Potential	kg PO4 eq.	0.00961	0.00221
Photochemical Ozone Creation Potential	kg Ethene eq.	0.00524	-0.00116
Abiotic Depletion Potential (Elements)	kg Sb eq.	0.000191	4.49E-08
Abiotic Depletion Potential (Fossil)	MJ	150	21.5

Parameters describing primary energy	Units	Production *(A1-A3)*	Distribution and Installation *(A4-A5)*
Use of renewable primary energy excluding renewable primary energy resources used as raw materials	MJ, net calorific value	70.3	0.467
Use of renewable primary energy resources used as raw materials	MJ, net calorific value	654	0
Total use of renewable primary energy resources	MJ, net calorific value	724	0.467
Use of non-renewable primary energy excluding non-renewable primary energy resources used as raw materials	MJ, net calorific value	172	21.5
Use of non-renewable primary energy resources used as raw materials	MJ, net calorific value	0	0
Total use of non-renewable primary energy resources	MJ, net calorific value	172	21.5
Use of secondary material	kg	0	0
Use of renewable secondary fuels	MJ, net calorific value	0	0
Use of non-renewable secondary fuels	MJ, net calorific value	0	0
Net use of fresh water	m^3	0.0593	0.000373

Other environmental information describing waste categories	Units	Production *(A1-A3)*	Distribution and Installation *(A4-A5)*
Hazardous waste disposed	kg	0.0141	3.65E-05
Non-hazardous waste disposed	kg	0.192	0.00149
Radioactive waste disposed	kg	0.0133	2.55E-05

Other environmental information describing output flows	Units	Production *(A1-A3)*	Distribution and Installation *(A4-A5)*
Components for re-use	kg	0	0
Materials for recycling	kg	0	0
Materials for energy recovery	kg	0	0
Exported energy	MJ per energy carrier	0	0

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Environmental Parameters Derived from the LCA

End-of-Life

Parameters describing environmental impacts	Units	100% Recycling		100% Energy Recovery		100% Landfill	
		End-of-Life Processing (C1-C4)	Material and Energy Credits (D)	End-of-Life Processing (C1-C4)	Material and Energy Credits (D)	End-of-Life Processing (C1-C4)	Material and Energy Credits (D)
Global Warming Potential	kg CO2 eq.	64.9	-2.95	65.0	-45.7	76.0	-6.43
Ozone Depletion Potential	kg CFC11 eq.	1.97E-11	-9.30E-12	1.98E-11	-2.00E-09	2.90E-11	-3.80E-10
Acidification Potential	kg SO2 eq.	0.00362	-0.0123	0.0630	-0.119	0.123	-0.0221
Eutrophication Potential	kg PO4 eq.	0.000591	-0.00148	0.0125	-0.0106	0.00860	-0.00185
Photochemical Ozone Creation Potential	kg Ethene eq.	0.000150	-0.00140	0.00634	-0.00735	0.0186	-0.00126
Abiotic Depletion Potential (Elements)	kg Sb eq.	3.05E-08	-5.80E-08	3.20E-08	-1.10E-06	5.40E-07	-1.90E-07
Abiotic Depletion Potential (Fossil)	MJ	21.4	-30.7	23.3	-637	56.4	-82.2

Parameters describing environmental impacts	Units	100% Recycling		100% Energy Recovery		100% Landfill	
		End-of-Life Processing (C1-C4)	Material and Energy Credits (D)	End-of-Life Processing (C1-C4)	Material and Energy Credits (D)	End-of-Life Processing (C1-C4)	Material and Energy Credits (D)
Use of renewable primary energy excluding renewable primary energy resources used as raw materials	MJ, net calorific value	0.356	0.0106	654	-30.3	1.84	-5.95
Use of renewable primary energy resources used as raw materials	MJ, net calorific value	-654	0	-654	0	0	0
Total use of renewable primary energy resources	MJ, net calorific value	-653	0.0106	0.357	-30.3	1.84	-5.95
Use of non-renewable primary energy excluding non-renewable primary energy resources used as raw materials	MJ, net calorific value	22.5	-30.8	24.4	-749	57.9	-104
Use of non-renewable primary energy resources used as raw materials	MJ, net calorific value	0	0	0	0	0	0
Total use of non-renewable primary energy resources	MJ, net calorific value	22.5	-30.8	24.4	-749	57.9	-104
Use of secondary material	kg	0	40.3	0	0	0	0
Use of renewable secondary fuels	MJ, net calorific value	0	0	0	0	0	0
Use of non-renewable secondary fuels	MJ, net calorific value	0	0	0	0	0	0
Net use of fresh water	m^3	0.00182	-0.00255	0.0415	-0.125	-0.0373	-0.0246

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Parameters describing environmental impacts	Units	100% Recycling		100% Energy Recovery		100% Landfill	
		End-of-Life Processing (C1-C4)	Material and Energy Credits (D)	End-of-Life Processing (C1-C4)	Material and Energy Credits (D)	End-of-Life Processing (C1-C4)	Material and Energy Credits (D)
Hazardous waste disposed	kg	0.000470	0.000835	0.000472	-0.0492	0.00129	-0.00942
Non-hazardous waste disposed	kg	0.00386	-0.0404	0.00386	-0.186	17.2	-0.0301
Radioactive waste disposed	kg	0.000451	-7.00E-05	0.000452	-0.0474	0.000611	-0.00907

Parameters describing environmental impacts	Units	100% Recycling		100% Energy Recovery		100% Landfill	
		End-of-Life Processing (C1-C4)	Material and Energy Credits (D)	End-of-Life Processing (C1-C4)	Material and Energy Credits (D)	End-of-Life Processing (C1-C4)	Material and Energy Credits (D)
Components for re-use	kg	0	0	0	0	0	0
Materials for recycling	kg	40.3	0	0	0	0	0
Materials for energy recovery	kg	0	0	0	0	0	0
Exported energy from Electricity	MJ	0	0	216	0	41.5	0
Exported energy from Thermal Energy	MJ	0	0	216	0	0	0

***Represents use of secondary material in next product system**

References

DfT 2005	Department for Transport, 2005. Continuous Survey of Road Goods Transport. Department for Transport, London, UK.
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PE International 2013	PE International, 2013. *GaBi 6 Software and Database for Life Cycle Engineering.* Data on the manufacture of galvanised steel sheet. LBP, University of Stuttgart and PE International, Stuttgart, Germany
Wood First 2014	PE International and Wood For Good. *Kiln dried sawn softwood*. Timber Trade Federation, London, UK
worldsteel 2011	World Steel Association, 2011. *World Steel Association Life Cycle Inventory Study for Steel Products*. World Steel Association (worldsteel), Brussels, Belgium