

Life Cycle Assessment of Construction Timber Products

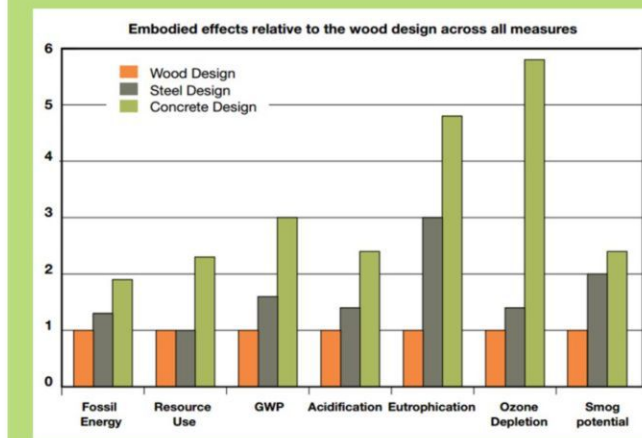
Introduction -

The LCA (Life Cycle Assessment) is an important decision making tool for the design and construction of sustainable buildings. It provides a method to compare materials using benchmarks and standards which enable designers, clients and contractors to evaluate their procurement and design options. The CEN/TC 350 Modular Framework for an LCA is shown from stages A-C, with addition of D (outside the whole life cycle).

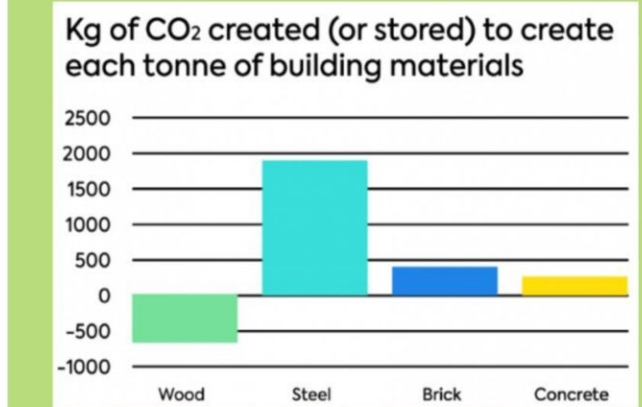
The environmental impacts of materials can be measured through the whole life cycle.

Construction timber is considered one of the most environmentally friendly building products, as well as it's associated manufactured bi-products in sheet form such as MDF, OSB and Laminates.

It can be sustainably sourced, requires low embedded energy throughout its life cycle and is a capable build material with regard to strength, flexibility, workability, appearance and longevity.



(Canadian Wood, 2020)



(Citu.co.uk, 2020)

- The UK consumes 17 million m³ of wood each year.
- Every 1m³ of timber absorbs 1 tonne of CO₂10.5 million m³ solid wood.
- 6.5 million m³ sheet materials.
- 61% used in construction. (Cti-timber.org, 2020)

Raw Material Supply -

The majority of timber used for construction is solid softwood from conifers. These are Scots Pine, Douglas Fir, European Whitewood, European Redwood, Western Red Cedar and Sitka Spruce. It can grow to maturity in as little as 25 years but generally 50-100 years.

Most softwood used in the UK comes from Sweden, UK, Finland, Latvia and Russia with imports at about 80% of consumption.

In the UK about half of forest plantations are responsibly managed to standards such as FSC (Forest Stewardship Council) and the UKFS (UK Forestry Standard).

Transport -

It is estimated that 49% of all greenhouse gas emissions from the production of timber from transport.

CEN/TC 350 identifies 3 main stages of transport -

- Raw material supply from the forestry/woodland to the processing/manufacturing facility. This may involve two steps e.g. sawmill and manufacturing sites for Glulam.
- Transport from manufacturing to suppliers (and on to construction site) or direct to construction site.
- Transport from a demolished site to waste processing facility or to disposal. There may also be transport to a re-manufacturing site for recycling the timber.

Emissions are made up from direct and indirect emissions. Direct emissions are from the fuel used during transportation, indirect emissions from the production of timber trucks, maintenance to trucks and roads, consumables such as tyres and oil.

Manufacturing -

Approximately half of the tree can be used for timber. This will be sawn to size, graded and kiln dried to reduce the sap and moisture content.

Typical grading for softwood is C14-C50 with most commonly used grades C16 and C24. The higher the structural grading the stronger it is. British Standard BS4978.

The timber can be further processed as Glulam laminated structural beams or chemically treated to increase the lifespan of the wood.

Pre-fabricated sections can be manufactured such as roof trusses, timber frame walls and floors. Complete modular systems can also be created. This reduces construction time and cost.

Offcuts and woodchips from the forestry as well as sawdust created during cutting can be used to create laminate/composite sheet materials such as OSB and MDF. It can also be used as biomass for high energy processes such as kiln drying.

Construction installation process -

Timber materials will be supplied ready for construction as -

- Solid timber lengths
- Glulam/cross laminated solid lengths
- Sheet materials such as OSB, Plywood, MDF

OR Pre-constructed(manufactured, fabricated) sections will be supplied such as -

- Roof trusses (trussed rafters)
- Timber frame walls and floors
- Entire modular room units

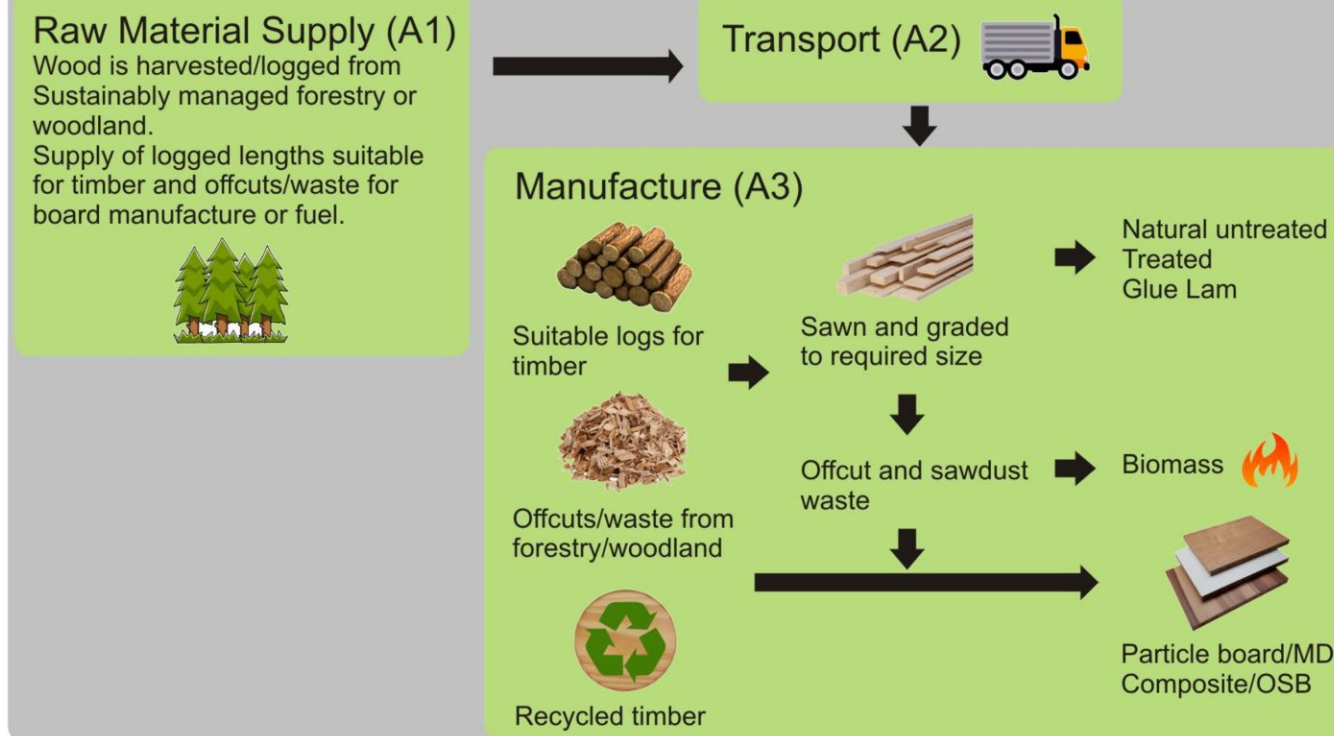
The advantages of using timber on site are -

- Quick construction
- Low energy use during construction
- Low emissions from the construction process
- Cost effective
- Waste can be recycled

British Standard BS5268 outlines how structural timber can be used in construction.

CEN/TC 350 Modular Framework

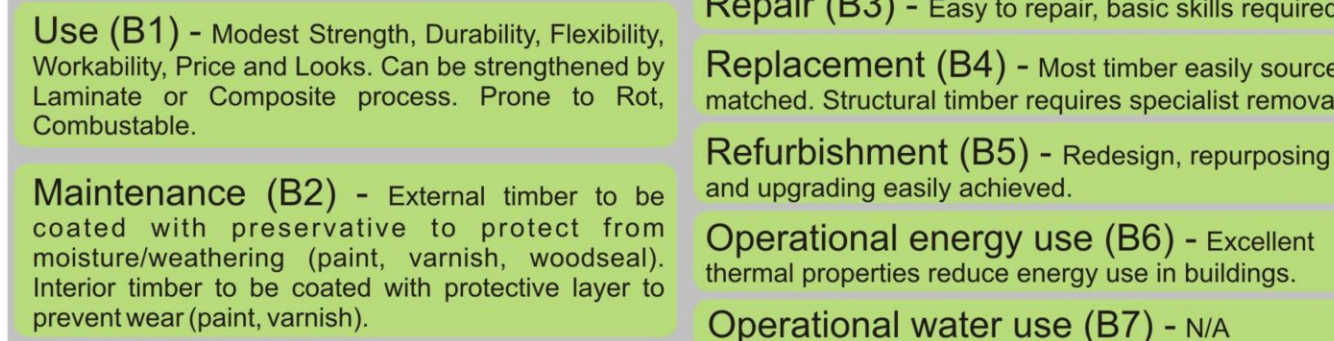
Product Stage A1-3



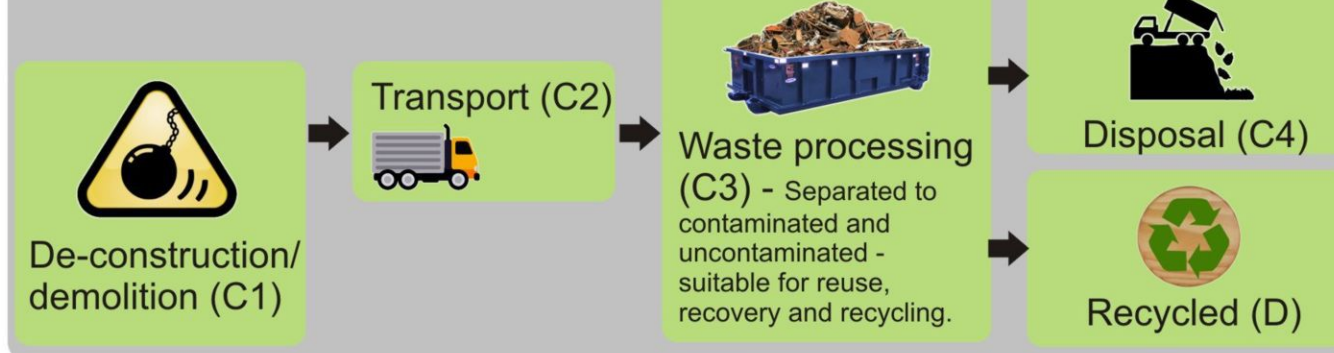
Construction Process Stage A4-5



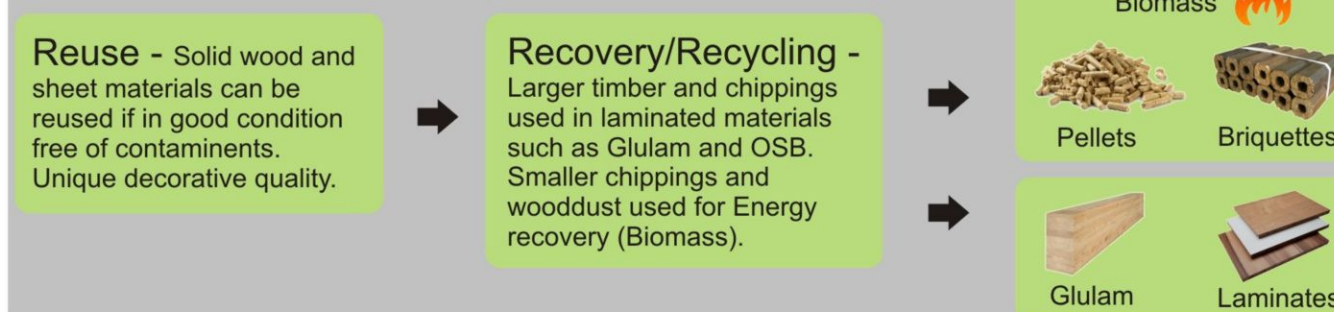
Use Stage B1-7



End of life Stage C1-4



Benefits and loads beyond the system boundary - D



Sustainable Forestry Carbon Cycle



End of Life Stage -

The demolition phase of the building at the end of life -

- This can be done quickly at a low cost with a modest amount of timber product set aside for recycling.
- Alternatively a more lengthy and careful process will allow for recovery of larger structural and sheet elements. This will allow for a greater level of timber re-use and recycling.

Timber that is contaminated with metals, glass, paper, plastic, rubber and chemical treatments will be more difficult to recycle or use as biofuel.

Use Stage -

Timber is an extremely versatile material. If well designed, manufactured and constructed it will last a very long time. Durability and strength will be affected if timber degrades due to rot, chemical attack, organic/pest attack, excessive heat (flame), UV and wear. If purposed correctly it will be protected against such threats. During the life of the building it will provide good thermal insulation and sound proofing.

Maintenance, Repair, Replacement and Refurbishment to timber is easily carried out at a low cost without any specialist skills (unless structural). Processes involve re-coating for protection, re-finishing for aesthetics, repairing damaged elements, replacing damaged elements or altering design elements.

Benefits and loads beyond the system boundary -

Timber products can often be re-used without re-manufacture. More durable materials such as structural beams and sheet products that have survived the demolition process are used for the benefit of affordability, 'green credentials' and unique appearance.

Most timber waste is recycled as offcuts, wood chips and sawdust to be remanufactured as -

- Glulam or Crosslam (CLT)
- OSB board, Fibreboard, Plywood
- Composite lengths or board
- Biomass pellets and briquettes

Conclusions -

Timber is probably the most environmentally friendly construction materials available. The advantages to using timber over alternatives such as steel and concrete are -

- The growing cycle of wood takes CO₂ out of the atmosphere and acts as a store (carbon capture) until it decays or is burned. See above image.
- Wood/timber is a sustainable resource (from managed plantations) unlike finite (mined) resources.
- The embodied energy used during the manufacturing processes involved in creating solid or sheets materials is low compared to alternative materials.
- Timber can be recycled to make new timber products.
- Timber waste can be used directly as biofuel or manufactured to biofuel products such as briquettes.
- Timber products offer excellent properties such as strength, appearance, workability over a varied range of solid and sheet materials.
- It is cost effective to procure, maintain and dispose of.
- It has excellent thermal insulator.

The disadvantages are -

- Transport cost is high if we continue to import such a high percentage to the UK. Ultimately it should be sourced locally where possible.
- Timber requires heat shielding to be used safely.
- It can be difficult to recycle if treated with hazardous chemicals or laminated with non-recyclable materials.
- Its lesser strength compared to concrete and steel limit its use to smaller sized builds with smaller spans and weight loading.

References -

Canadian Wood. (2020). A quick lowdown on lca of building materials and why wood emerges as a winner - Canadian Wood. [online] Available at: <https://www.canadianwood.in/a-quick-lowdown-on-lca-of-building-materials-and-why-wood-emerges-as-a-winner/> [Accessed 13 Feb. 2020].

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