

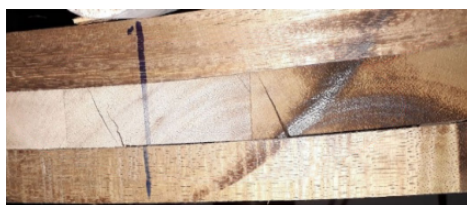
MASS TIMBER ADHESIVES

Adhesives laminate layers of wood together to create mass timber products. Adhesives are selected for appearance, cost, and various standards they meet to ensure the quality of the finished product.

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About Adhesives

Adhesives will impact the structural performance of engineered wood mass timber products such as Glulam, CLT, and LVL in the medium term and the long term. Performance metrics include moisture resistance to prevent delamination, glue line shear strength, percentage of torn grain and creep, and heat resistance [1].



Failure due to rolling shear near glue lines in PRF-bonded CLT. Image Credit: Yousof et. al, 2019.

To meet these performance criteria, adhesives follow the O112 Series of CSA Standards on Wood Adhesives [1]. There is also a list of Heat Resistant Adhesives approved by the Canadian Lumber Standards Accreditation Board (CLSAB) , revised in September 2020 [2]

Health

Adhesives containing formaldehyde may volatilize during the manufacturing process of mass timber, making it essential to maintain low levels of formaldehyde for the safety of manufacturing workers [8]. Small amounts of formaldehyde - also produced by people, plants, and animals - are readily broken down by the body and are not considered harmful [9]. As high concentrations of formaldehyde can cause health risks, regulations exist to limit the amount of formaldehyde emitted by adhesives. While wood product formaldehyde emissions are not regulated in Canada, standards for wood product manufacturing are in place [9]. When these are evaluated against various international regulations for formaldehyde emissions, Canadian mass timber products meet the guidelines [9]. Once cured in the finished mass timber product, certain formaldehyde-based adhesives (phenol formaldehyde, resorcinol formaldehyde, phenol resorcinol formaldehyde, and melamine formaldehyde polymers) are more stable than others (urea formaldehyde) and do not release VOC's [8]. New formulations of glue without formaldehyde – such as PUR – have also entered the market to address workplace safety during the lamination process [8]. Some natural adhesives of interest that are not yet widespread in industrial use include tannin adhesives combined with hardeners that do not emit formaldehyde, lignin adhesives, and unsaturated oil adhesives [10].

References and Further Reading

1. FPInnovations. (2010, May 20). *Manufacturing Cross-Laminated Timber (CLT) Technological and Economic Analysis*. PDF. <https://library.fpinnovations.ca/en/viewer?file=%2Fmedia%2FWP%2FE4676.pdf#search=Manufacturing%20cross-laminated%20timber&phrase=false&pagemode=bookmarks>, pg. 5
2. CLSAB. (2020, September 2). *Adhesives Accepted by CLSAB for HRA Labelling*. PDF. https://www.clsab.ca/wp-content/uploads/2020/09/CLSAB_Accepted_Adhesives_for_HRA_labelling_2020_09_02.pdf
3. Grandmont, J.F., Yeh, B., Dagenais, C. (2019). Cross-laminated timber manufacturing. In E. Karacabeyli & S. Gagnon (Ed.), *Canadian CLT handbook*. FPInnovations. <https://web.fpinnovations.ca/clt/>, pg. 16.
4. Grøstad, & Pedersen, A. (2010). Emulsion Polymer Isocyanates as Wood Adhesive: A Review. *Journal of Adhesion Science and Technology*, 24(8-10), 1358. <https://doi.org/10.1163/016942410X500981>.
5. Frihart. (2015). Introduction to Special Issue: Wood Adhesives: Past, Present, and Future. *Forest Products Journal*, 65(1-2), 6. <https://doi.org/10.13073/65.1-2.4>
6. Nordic. (2018). Environmental Product Declaration: Nordic Lam. https://www.nordic.ca/data/files/datasheet/file/EPD_Nordic_Lam.pdf
7. Structurlam Mass Timber Corporation. Environmental Responsibility. Retrieved January 4, 2022 from <https://www.structurlam.com/resources/certifications/>. See “Green Guard Low Chemical Emissions PUR: Glulam & CLT”.
8. Grann, B. (2019). Environmental performance of cross-laminated timber. In E. Karacabeyli & S. Gagnon (Ed.), *Canadian CLT handbook*. FPInnovations. <https://web.fpinnovations.ca/clt/>, pg. 23.
9. APA. (2018). *Formaldehyde and Engineered Wood Products*. <https://apawood-europe.org/wp-content/uploads/2018/06/Formaldehyde-and-Engineered-Wood-Products.pdf>
10. Pizzi, A. (2016). Wood products and green chemistry. *Annals of Forest Science*, 186, 187, 190.
11. Yousof et. al, 2019. Mechanical and physical properties of Cross-Laminated Timber made from Acacia mangium wood as function of adhesive types.

Types of Adhesives

There are four types of adhesives used in structural wood [3]:

- Phenolic types such as phenol-resorcinol formaldehyde (PRF)
- Emulsion polymer isocyanate (EPI)
- Melamine formaldehyde (MF)
- One-component polyurethane (PUR).

Adhesives vary by their physical properties, markets, and the mass timber products in which they are used. This table summarizes a few common differences [3]:

Differences between Adhesive Types used for Mass Timber Products

Type	Colour when Cured	Regions/Markets	Product
PRF	Dark brown	North America	Glulam
EPI	Light coloured	Initially developed in Japan in the 1970s, EPI is commonly used Asia, with less widespread use but growing popularity in Europe and North America. [4]	Wood I-joists (at the end joints) and adhering the faces of layers in engineered wood products [5]
MF	Light coloured	Europe/outside of North America [5]	Glulam
PUR	Light coloured	Europe, Canada, and the US	This is the most commonly used adhesive to make CLT in the specified regions. Also used by some manufacturers for glulam. [6, 7]

Disclaimer: This summary of a complex topic is intended for educational purposes only and does not replace independent professional judgement or the need to delve further into the literature. The Mass Timber Institute neither endorses, approves nor assumes responsibility for the content, accuracy or completeness of the information presented.

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