






Cradle-to-Cradle Product Design

The most meaningful implementation of Cradle-to-Cradle design has happened at the material and product level, where certification is administered by the Cradle to Cradle Products Innovation Institute. Certificates are awarded to products based on the physical characteristics as well as the effects of the sphere of activity contributing to the existence of the product. Such things include the chemicals involved in processes, the factory environment, social context and strategic management surrounding the product. This factsheet focuses on the design aspect of the certification.

C2C Certification Criteria: the Five Categories






-  **Material health** No known or potentially harmful substances within the product. The Institute manages a list of Banned Chemicals which should not appear in a Platinum product
-  **Material reutilization** Eliminate the concept of waste. For every material in the product, the percentage of recyclable, biodegradable (including compostable), rapidly renewable and recycled content is quantified and placed into a formula to derive the rating. A perfect score is needed.
-  **Renewable Energy and Carbon Management** All greenhouse gas emissions resulting from the manufacture of the product to be offset. Note: The renewable energy portion of this category requires that all energy inputs be renewable
-  **Water Stewardship** The water leaving a production site must be of drinking water quality
-  **Social Fairness** The production processes do not harm the health and safety of workers, for example by exposure to toxic chemicals

Applying C2C to produce a long-span timber beam product

The Problem with Conventional Glulam Beams

Three types of glulam resin are listed in the EN standard (Normalisatie-instituut, 2013), all of which involve formaldehyde either in the production process or the end product. This is a confirmed human carcinogen with high acute toxicity ("Cradle to Cradle Certified Product Standard: Material Health Assessment Methodology," 2013)






C2C assessment: glulam

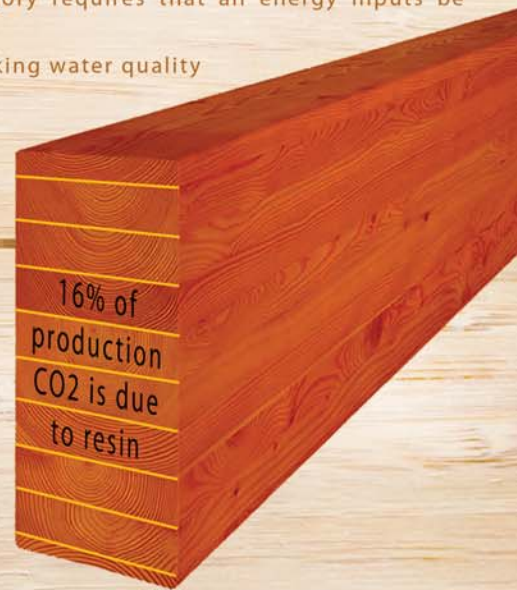
-  Formaldehyde content is not allowed in the end product. Off-gassing may present a health issue in the long term
-  The resin is derived from non-renewables and is a technical nutrient chemically bonded to timber, a biological nutrient. This makes the glulam a monstrous hybrid which is difficult to recycle.
-  Carbon-negative footprint overall, so this category is already at Platinum level. However, the carbon emissions due to resin production in the glulam account for 16% of the total process emissions (Bribián, Capilla, & Usón, 2011).
-  The mixing of toxic chemicals to produce the resin will likely lead to minor water contamination when containers are cleaned or instruments rinsed
-  Workers are potentially exposed to formaldehyde in the long term

Dowell Laminated Beams as a C2C-Platinum solution

Recent developments in high-speed wood-welding have been utilized to produce a dowelled-laminated timber solution. It involves dowels being inserted by high-speed rotation welding into the laminae substrate to produce a resin-free bond.

C2C assessment: dowlam

-  The product is entirely made up of a single species of timber
-  The product is entirely made of renewables, easily recyclable and biodegradable.
-  Carbon-negative footprint, and potentially 16% less emissions from production process
-  Effluents can potentially be of drinking water quality
-  Workers no longer exposed to formaldehyde



In conclusion, there is potential for a Cradle-to-Cradle Platinum-certified dowlam beam, providing a rigorous management framework can be delivered around it.

Bocquet, J. F., Pizzi, A., Despres, A., Mansouri, H. R., Reich, L., Michel, D., & Letort, F. (2012). Wood joints and laminated wood beams assembled by mechanically-welded wood dowels. *Journal of Adhesion Science and Technology*, 21(3-4), 301-317. doi:10.1163/156856107780684585

Bribián, I. Z., Capilla, A. V., & Usón, A. A. (2011). Life cycle assessment of building materials: comparative analysis of energy and environmental impacts and evaluation of the eco-efficiency improvement potential. *Building Environment*, 46(3), 1133-1140.

Cradle to Cradle Certified Product Standard: Material Health Assessment Methodology. (2013). Retrieved from http://s3.amazonaws.com/c2c-website/resources/certification/standard/Product_Standard_Material_Health_Methodology_FINAL_Nov_4_2013.pdf

Normalisatie-instituut, N. (2013). NEN-EN 14080:2005 en - Glued Laminated Timber and Glued Solid Timber Timber Structures. Delft.