1. Submission Information

1.1. Contact Information

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1.2. Submitting Categories

Professional | Aluminum
2. Product Description and Image

2.1. Bench

Bench’s design is inspired by the imperative weight reduction in airplane construction. Based on one of the principles of design, repetition, 32 wooden spars form the seating surface and are held together by 80 metal parts. Reusing parts multiple times and aligning the elements with ample negative space creates a lightweight appearance. The spars in the prototype version are CNC-milled plywood. Future customers could select from various wood products such as FSC-Certified plywood or C2C Certified Accoya® wood.

The natural tone of the wood invites one to sit down and take a break. In stark contrast, the strength of the aluminum parts is emphasized by the cool surface qualities (polished or brushed).

The legs are water-jet cut ½ inch aluminum plate. Two structural cross-members are welded out of ½ inch aluminum rod. The spacers and washers are lathed out of 1 inch aluminum rod. Recycled stainless steel screws and threaded steel rods hold the parts together.

This design approach results in a sturdy, yet extremely lightweight bench, which has material and assembly properties that enable a circular, regenerative future.

2.2 Image

Full-scale Prototype
2.3. Illustration of the product’s system

The bench32 design company sources the parts from various certified suppliers. The custom-ordered product is assembled and shipped to customer expectations.

3. Reutilization Cycle and Business Model

The design construction of the bench32 allows for simplified disassembly. Metal and wood parts can easily be separated and channeled into the appropriate life cycle stream.

The proper maintenance by the customer or the opportunity to refurbish the product prolongs the use.

Disassembly would be achieved through a company take back program which is funded through a premium when the bench is ordered.
4. Material Selection

4.1. Overview

Bench is made of the following parts:

<table>
<thead>
<tr>
<th>Part</th>
<th>#</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wooden Spar</td>
<td>x32</td>
<td>Plywood, CNC-milled</td>
</tr>
<tr>
<td>Legs</td>
<td>x3</td>
<td>½ inch aluminum plate, water-jet cut</td>
</tr>
<tr>
<td>Leg Protector</td>
<td>x3</td>
<td>3D printed, recycled filament</td>
</tr>
<tr>
<td>Spacer</td>
<td>x62</td>
<td>1 inch aluminum round stock, lathe</td>
</tr>
<tr>
<td>Washer</td>
<td>x4</td>
<td>1 inch aluminum round stock, lathe</td>
</tr>
<tr>
<td>Structural Cross-member</td>
<td>x2</td>
<td>½ inch aluminum rod, bent &amp; welded</td>
</tr>
<tr>
<td>Threaded Steel Rod</td>
<td>x2</td>
<td>½ inch diameter</td>
</tr>
<tr>
<td>Stainless steel screws</td>
<td>x7</td>
<td>Recycled torx screws</td>
</tr>
</tbody>
</table>

The ECOLUM™ aluminum products are selected from Alcoa’s SUSTANA™ Aluminum Product Line, “a full range of cast products that are among the least carbon-intensive products available today, yielding a 75% lower carbon impact than the industry average. These products are produced at hydro-powered smelters that generate less than 2.5 metric tons (MT) of carbon dioxide per MT of aluminum. Alcoa provides certificates of origin that enable customers to verify the sustainability benefits when reporting on their own operations.”

When ordering, the customer can select from various spar materials:
- FSC-Certified Wood | Green Building Standards Plywood
- C2C Certified Accoya® wood
  [c2ccertified.org/products/mhcertificate/accoya_wood_radiata_pine_alder](http://c2ccertified.org/products/mhcertificate/accoya_wood_radiata_pine_alder)

Currently, I am investigating additional spar material choices made from recycled plastics such as ECO™ by Cosentino, “composed of recycled materials bound with a resin that is partially derived from corn oil.”

When ordering, the customer can select from various spar materials:
- FSC-Certified Wood
  [c2ccertified.org/products/mhcertificate/accoya_wood_radiata_pine_alder](http://c2ccertified.org/products/mhcertificate/accoya_wood_radiata_pine_alder)

4.2. Material Reutilization

Cradle to Cradle Material Reutilization Equation

\[(79\% \times 1) + (100\% \times 2) / 3 = 93\]

The score is possible through the use of aluminum, wood and steel. Material waste (metal and wood) during production is recyclable as well as each part of the product. The degree of available recycled aluminum has a considerable impact on the equation. If recycled aluminum could be sourced, the score changes to 100.

4.4. Impact Statement

Sourcing the right materials has a huge impact on the performance of the product, both from a user’s perspective and from a life cycle point of view. The design of the bench in regards to its assembly and disassembly is optimized for constantly improving the selection of the best C2C materials available.

4.3. Material Health

Aluminum: NFPA health score 0

Stainless Steel: NFPA health score 0
[mscdirect.com/MSDS/MSDS00030/00052050-20160831.PDF](http://mscdirect.com/MSDS/MSDS00030/00052050-20160831.PDF)

Accoya® Wood: Overall Certification Level: Gold
[C2C Certified](http://c2ccertified.org/products/scorecard/eco_by_cosentino)

FSC-Certified Wood
5. Design with Autodesk’s Fusion 360™

My first CAD program I learned was Alias Studio. Recently, after Jeff Smith came to visit our campus for a demo, which was very convincing, I had Fusion360 installed in our computer lab.

I used the bench design as a test project to learn more about Fusion 360. The curves for the spar were modeled in Alias and then imported into Fusion. The software allowed me to test various proportions regarding the number of spars used, the positioning of the legs and the extend of the overhang.

I think this CAD/CAM software is very compelling. I love the interactivity of the marking menu combined with the logical flow. My plan is to offer Fusion360 classes in the future.