GENERAL LONGBOARD SCIENCE – HOW TO BUILD A LONGBOARD FROM SCRATCH

Jelle Feitsma, Sam Voncken

Supervisor: Leonie Titulaer, PhD, Chemistry teacher, Porta Mosana College Maastricht

Porta Mosana College, Maastricht, The Netherlands. sam.voncken@hotmail.nl; jellefeitsma@gmail.com

1. Introduction

In this profile project, we combined design, research and construction in one assignment: we constructed and tested a self-designed cruiser-type longboard. Designing and building a longboard involved researching a number of important aspects related to physics and chemistry and included some biological and societal considerations: we aimed to carry-out this project in a sustainable manner. For this reason, this project is entitled: "*General Longboard Science*".

2. Research Methods

We have designed and produced all important parts of the longboard ourselves: this included the deck, the trucks and the wheels. We also had to construct our own tools and molds to accomplish this profile project. For each part of the longboard, a design-cycle was followed: a) global analysis and description of the design, b) definition of a program of requirements (properties and dimension), c) devising a practical approach and formulating the design, d) realize the design and e) testing and evaluating the final product. This systematic approach enabled us to determine how the parts of the longboard could be made and which preparations and actions were needed. Each final product was compared to the original program of requirements

3. Results

To keep production costs low, most of the materials used were generously sponsored by companies (aluminum, urethane) and/or recycled (high-density polyethylene (HDPE). All parts of the longboard had to be sturdy and safe. The deck needed to be able to hold the weight of an adult (±70-80 kg), it had to be flexible and light (flexibility provides shock absorption). Stability and strength were achieved in length (105 cm) and simultaneous concave and camber design, in addition to inclusion of a spine/rib structure along the longitudinal axis of the deck; this concept was roughly based on the nervature that supports a banana leave. Molten HDPE plastic was pressure-molded into a self-constructed concrete/steel mold; excess plastic was trimmed and the deck was finished by sanding and varnishing. The trucks were cast from an aluminum alloy using a sandcasting method. The prototypes for the two parts of the trucks, the hanger and the base plate, were made using a 3D-printer. These elements were then pressed into a home-made sandcasting mold. Upon setting of the aluminum alloy cast, excess metal was removed and the trucks were finished by grinding and filing. 3D-printed molds were used to cast polyurethane wheels. The wheels were cast with a hard-plastic core inside that contained the ball-bearings that ensured friction-free wheel rotation.

The quality of the end products was scientifically tested in professional settings. Tensile strength diagrams of the HDPE plastics for the deck were determined using specialized equipment and 4-point flexural strength was estimated based on the dimensions of the board and the measured tensile strength (*figure 1a-c*). The quality of the aluminum alloy structure was microscopically analyzed. The presence of large artefacts (air bubbles) in the casts was excluded by Röntgen analysis (*figure 2*). The position of the cores and bearings in the polyurethane wheels (*figure 3*) was also confirmed by low-intensity X-ray imaging.

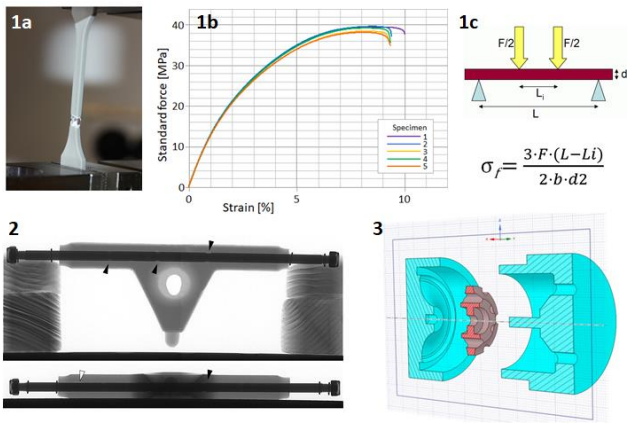

*Figure **1a,b**: tensile strength test and diagrams, **1c**: 4-point flexural strength (σ_f = flexural strength); **2**: Röntgen-image of a hanger (arrow heads - black: axel indentations; white: minor artefact); **3**: 3D-design of a wheel mold and core.*

4. Conclusion

What we have learned from this project is that it is absolutely necessary to thoroughly devise and elaborate all steps in advance. We have benefited greatly from the availability of a 3D-printer at school. Looking back, avoiding bubbles and releasing the deck from its mold provided the biggest challenges. We have absolutely enjoyed making the trucks: thorough preparation of sandcasting paid-off in a near-perfect set of trucks. The outcome of the X-ray analyses (truck and wheels) was a highlight of this project. A very instructive aspect of this project has been clear and motivated communication with professionals. The enthusiastic participation of these experts has been pivotal and very much appreciated by us.

5. References

https://drive.google.com/file/d/1T4CwiB7DQbwJgZ_pZESUe4iMIqwL6liQ/view