University of Ljubljana
Faculty of Mechanical Engineering

Center for Experimental Mechanics

Faculty of Mechanical Engineering, University of Ljubljana, Slovenia

CEM

E-LONGBOARD BATTERY ENCLOSURE MADE OF GLASS FIBRE

Tomaž Brzin, Marko Bek, Ted Prodan, Lidija Slemenik Perše

INTRODUCTION

This poster is presenting a whole manufacturing process from 3D modeling to final assembly of an electric longboard battery enclosure which serves as a protection for battery and other electrical components.

The enclosure was made of glass fibre done by the hand lay-up approach at the CEM laboratory.

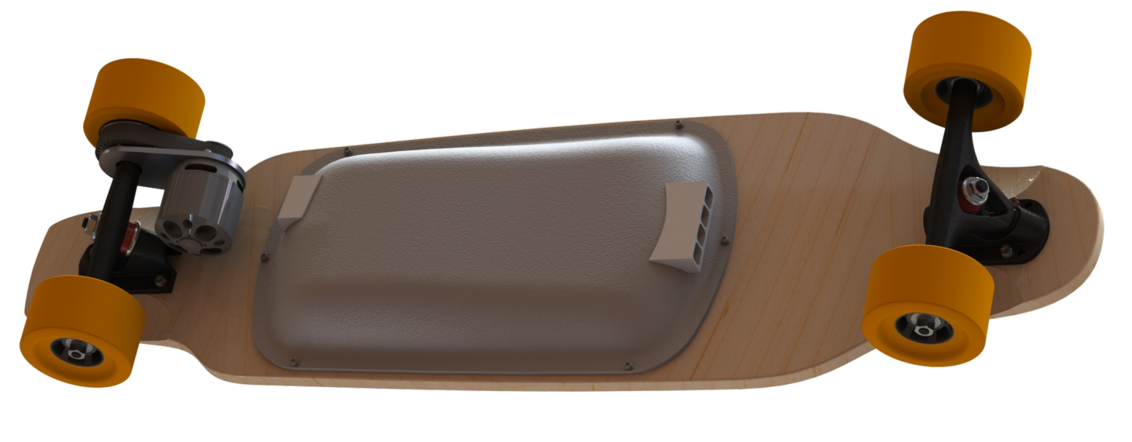

Figure 1: Bottom view of the battery enclosure

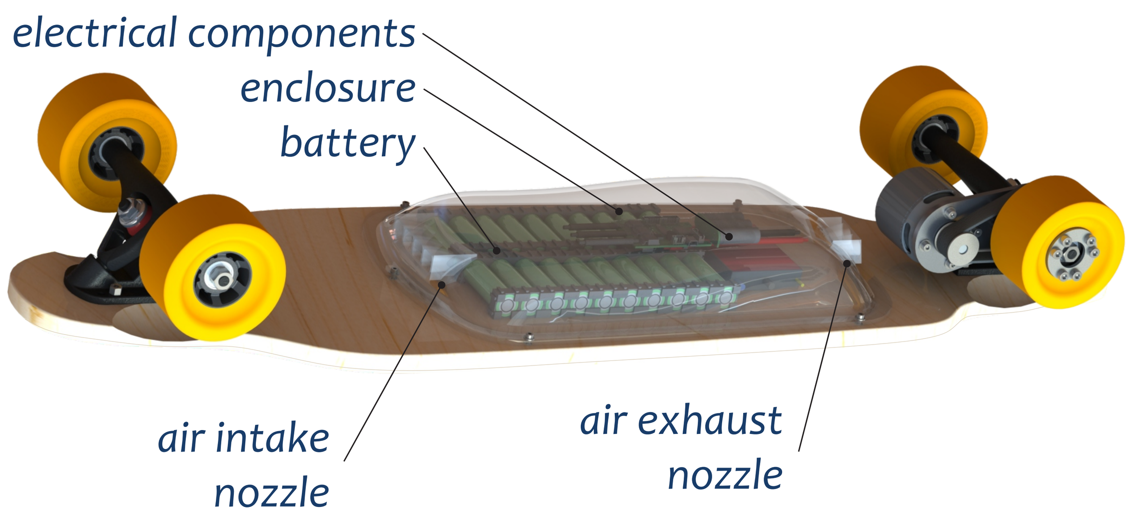

Figure 2: View with a transparent enclosure

3D MODELING

The first step was to design a CAD model of the enclosure. Required dimensional specifications (400 × 230 × 50 mm) and feasibility of the production process were taken into account. Large radius fillets were applied to make the production process easier.

Figure 3: Enclosure with wooden mould

Next step was to design a CAD model of the wooden mould. This operation was done with subtraction of the enclosure model and a simple rectangular solid. The concave shape shown in **Fig.** 4 was choosen to make the lamination proccess feasible.

Upper part of the mould assembly was also designed that during the curing process it would press on the enclosure's upper surface to retain a flat surface.

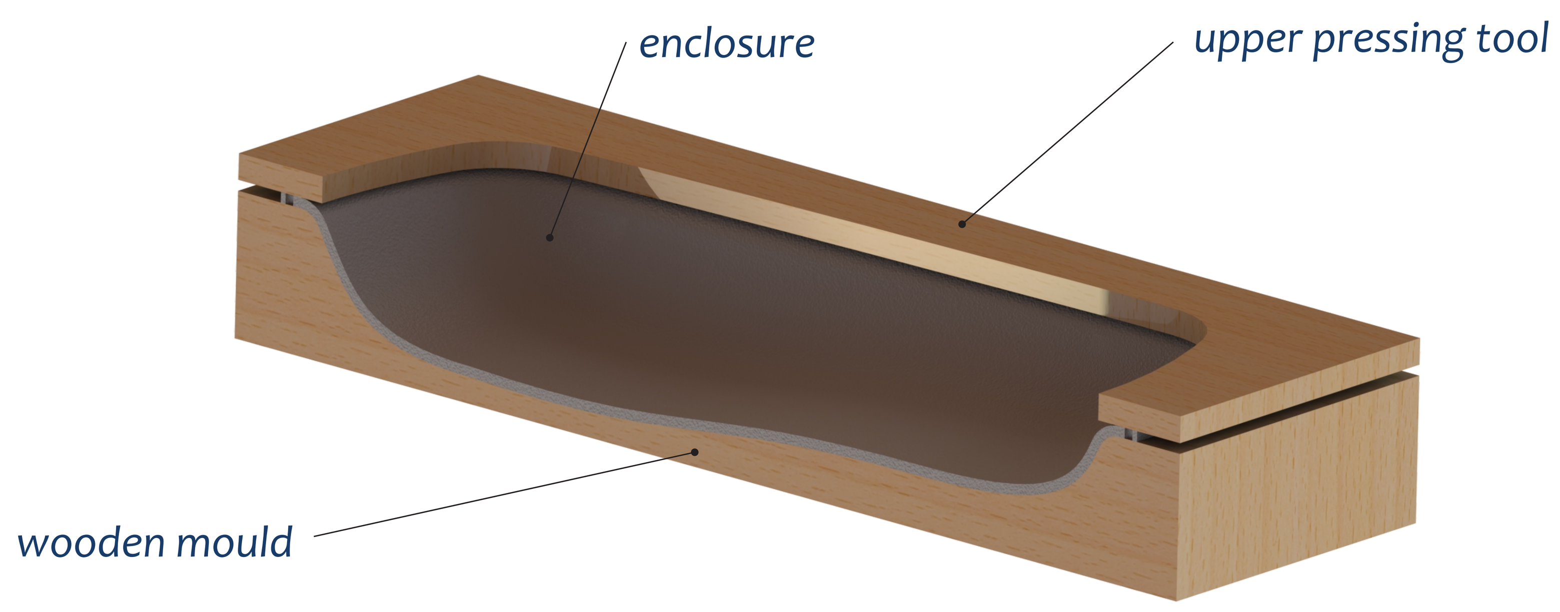

Figure 4: Cross-section of the mould assembly

MOULD MANUFACTURING

Properly manufactured and prepared mould is a foundation for well-made final product. The manufacturing process was completed in 2 main stages:

- CNC cutting and hand brushing
- Filler spray coating and polishing

CNC cutting was selected because of the enclosure's complex shape. Hand-brushed mould is shown in **Fig.** 5. Mould was spray coated at the local automotive workshop in order to obtain a smooth surface. This was neccessary to achieve easier separation of the mould and enclosure after curing process and also for nice surface finnish of the enclosure. Prepared mould is shown in **Fig.** 6.

Figure 5: Hand-brushed mould

Figure 6: (Polished) spray coated mould

LAMINATION PROCEDURE

This step was done by the hand lay-up approach. It was completed in two main stages, lainer construction which was followed by the main construction. Lay-up of latter was done after 4 hours of partial curing of the lainer which served for improved aesthetics. The structure is presented in **Fig.** 7.

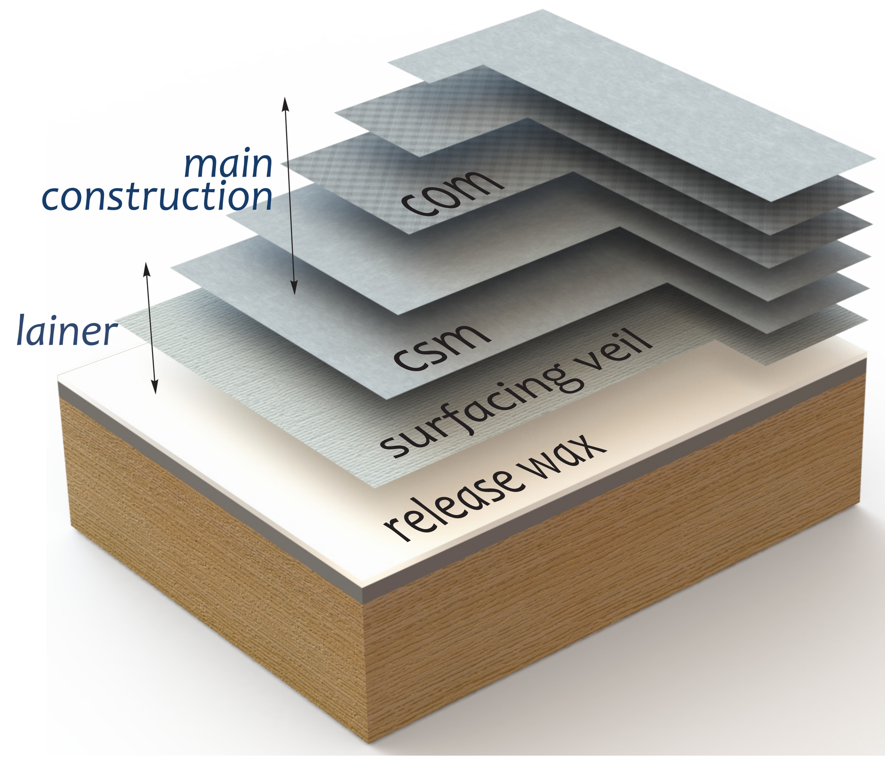

Figure 7: Cross-section of the structure

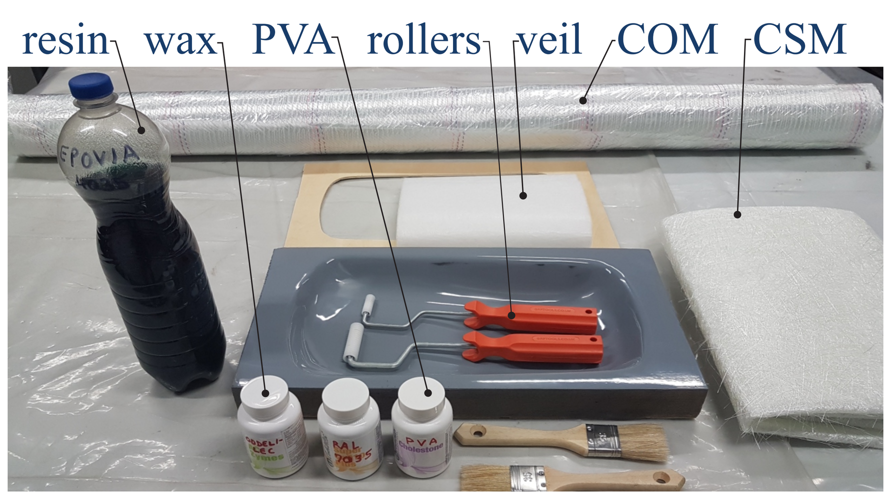

Figure 8: Gathered materials and tools

In both stages we used non-colored EPOVIA Optimum® 4035 epoxy resin

LAINER

1. REXCO Five® Mold Release Wax ( )
2. Thin PVA layer for good separation
3. Thin layer of chopped surfacing veil: 25 g/m² Viledon® ( )
4. One layer of chopped strand mat: 300 g/m² OCV Reinforcements M123 (CSM -)

MAIN CONSTRUCTION

5. One layer of chopped strand mat: 300 g/m² OCV Reinforcements M123 (CSM -)
6. Two layers of complex mat: 1300 g/m² SAERTEX LEO® (COM - CSM/+45°/-45° -)
7. One layer of chopped strand mat: 300 g/m² OCV Reinforcements M123 (CSM -)

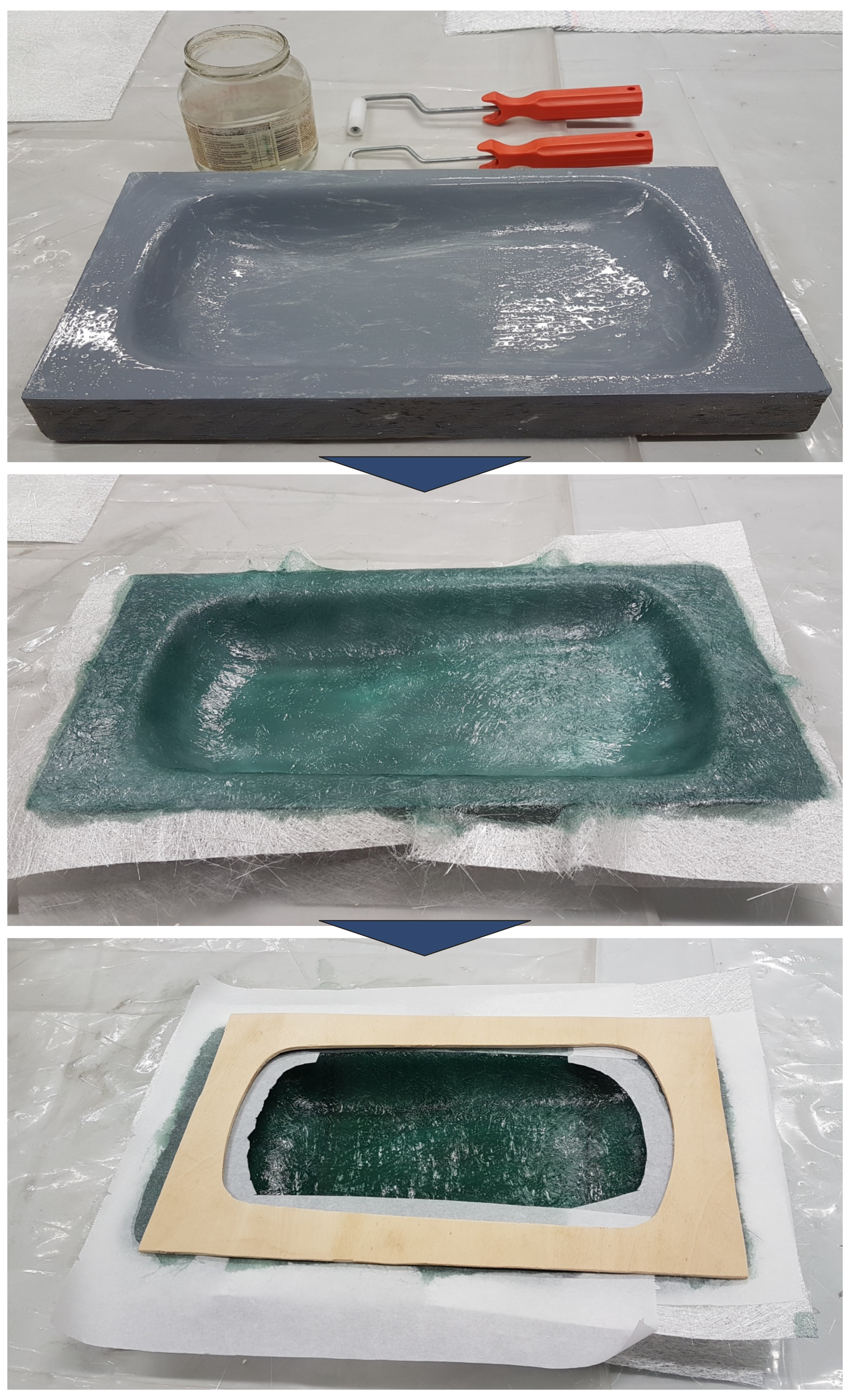

Figure 9: Lay-up procedure

AIRFLOW COOLING

Intake and exhaust air nozzles were added to the enclosure to achieve airflow circulation and cooling inside the enclosure while driving. However, this addition prevents driving in rainy conditions because water droplets could reach electronics. Different solution will have to be considered in the future. Sliced models of the nozzles are shown in **Fig.** 10.

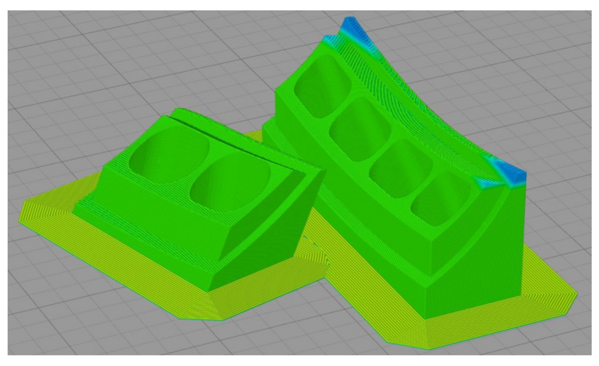

Figure 10: 3D printed nozzles

To verify the design of air nozzles, CFD analysis of the airflow was studied. The initial velocity of airflow was assumed to be 5 m/s based on average driving speed. The results are presented on 2 cross-section planes in **Fig.** 11.

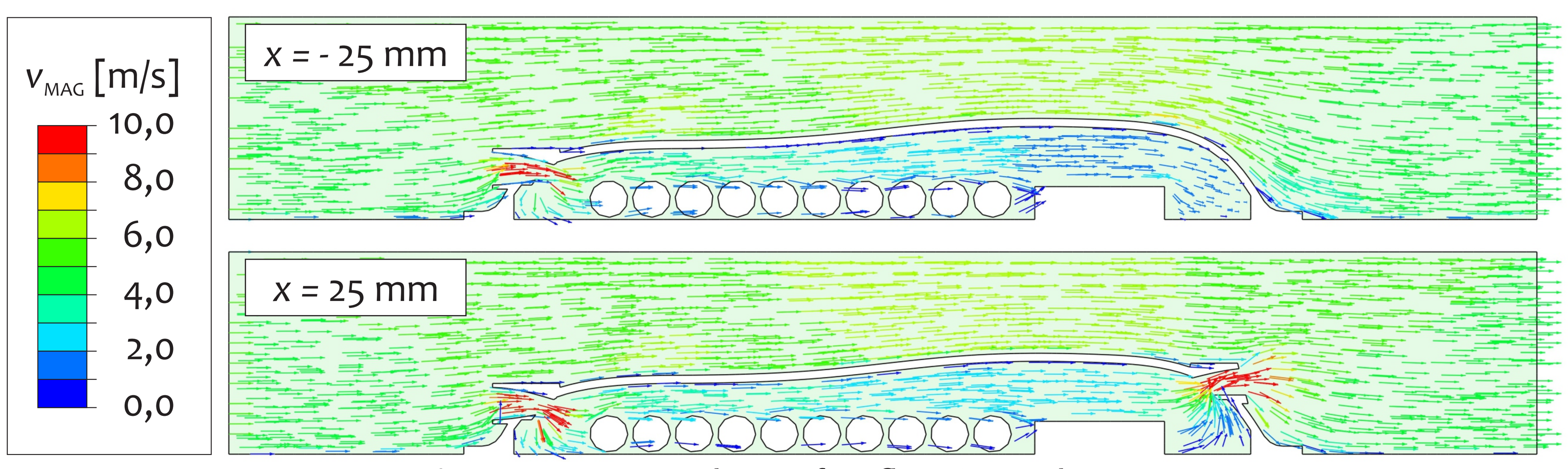

Figure 11: CFD analysis of airflow in enclosure

FINAL PRODUCT

Our final product mounted on the board is shown in **Fig.** 12.

Figure 12: Final product

Pot za Brdom 104, SI-1125 Ljubljana, Slovenia
Phone: (+386-1) 6207 100
e-mail: cem@fs.uni-lj.si