# COMPUTER AIDED DESIGN OF CO-EXTRUDED/COMPOSITE PROFILES AND PRODUCTION TOOLS

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## INTRODUCTION

In recent years, computational modelling tools have shown to be a powerful way to save resources in several industries, including polymer and composites processing. This framework has been allowing to replace the entirely experimental based trial-and-error design approaches by initial studies done with the support of computational modelling tools, with clear advantages for the results obtained. In this work we illustrate the numerical based design process of two cases studies from profile extrusion industry, aiming to: (i) balance the outlet flow of a co-extrusion die and (ii) improve the design of extruded profiles reinforced with continuous fibres. The work done required the employment of two different OpenFOAM solvers, interFoam, for the coextrusion die, and solids4Foam, for the mechanical design of the profile. These studies are being developed in the framework of a broader R&D project leaded by SOPREFA, which integrates also the University of Minho, University of Aveiro and the Portuguese Footwear Technological Centre (CTCP). SOPREFA is a well-known Portuguese pool cover and deck manufacturer and with this project, they aim to improve the performance of their traditional products.

## AIMS

Regarding the pool cover profile, the main objective of the project is the development of computational methods able to simulate the flow inside a pool cover co-extrusion die, aiming to balance the outlet flow of the three different fluids. Each fluid (polymer) plays an important role on the profile. In what concerns to the deck profile, it is composed by a PVC matrix and 40% rice shell, and the main goal of the study is to define the level of reinforcement with continuous glass fibres that assure appropriate mechanical behaviour.

## POOL COVER COEXTRUDED PROFILE

Three different materials feed the co-extrusion die (Polymer Inlets in the Figure 1). Varying their respective inlet velocities and areas it is possible to obtain profiles with different material ratios. The main goal is to obtain a thin profile with extra UV protection assured by the top thin layer.

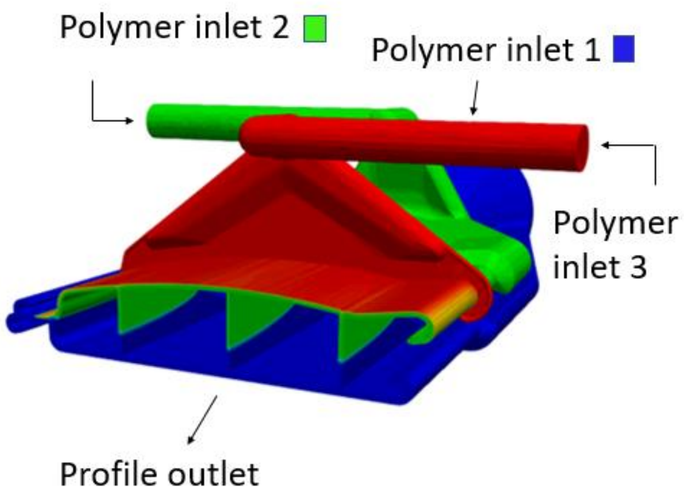


**Figure 1 – Pool cover co-extrusion die setup**

## DECK COEXTRUDED PROFILE

Glass fibres were included on the original SOPREFA's deck profile in specific regions (red regions of Figure 2b)). Time-varying displacement is applied (see Figure 2a)) at the symmetry plane, to mimic a flexural test. Three configurations were tested (see Figure 3), two of them with glass fibre-PVC pre-impregnated tapes and one with the original Soprefa's deck (unreinforced). Simulations were performed with solids4Foam [1-2].

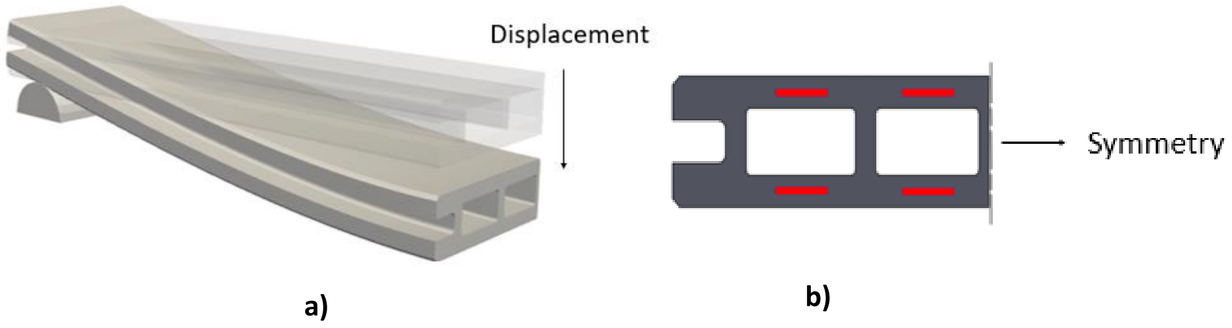


**Figure 2 – Pool deck profile flexural simulation setup a) and its cross sectional area b)**

| Case | Number of tapes on each red region of Figure 2b) | Tape layout on each red region of Figure 2b) |
|---|---|---|
| UR | 0 | Unreinforced (no glass fiber tapes) |
| V2H1 | 2 | |
| V2H2 | 4 | |

**Figure 3 – Pool deck cross sectional area configurations**

## RESULTS

### POOL COVER COEXTRUDED PROFILE

The numerical study allowed to obtain the desired thin layer of the UV polymer that assures UV protection.

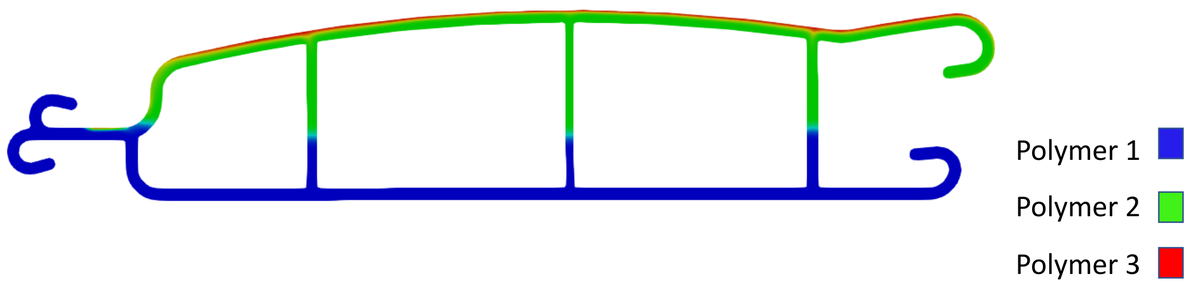


**Figure 4 – Pool cover cross sectional area**

### DECK COEXTRUDED PROFILE

The introduction of the tapes on the profile increases its resistance to flexural deformations, see Figure 5.

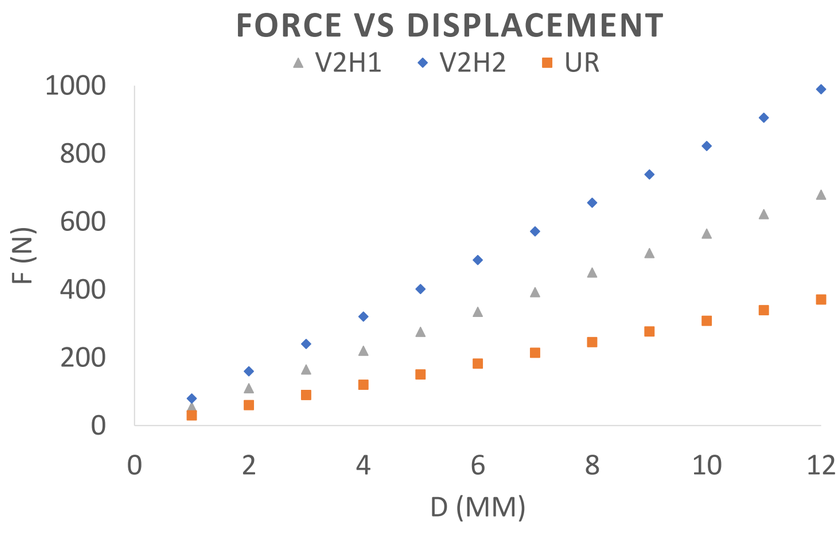


**Figure 5– Results obtained for deck flexural tests**

## REFERENCES

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