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Analysis of Frontal Pedestrian Collision and Redesign of Agile SCX

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1. Introduction

Agile Automotive is a Danish car manufacturer, which manufactures a sportscar called "Agile SCX". The SCX is currently being produced in low volume in a workshop in Vamdrup, making extensive use of

3. Redesign of the Bonnet

The aim of **redesign** is to **increase stiffness** of the bonnet, while fulfilling the regulation EC/78/2009. Stiffness is chosen as

composite materials. In order to introduce **Agile SCX** to the broader European market it needs to pass the United Nation Economic Commission for Europe Regulative EC/78/2009. The regulation

addresses safety performance of

cars impacting pedestrians and other vulnerable road users.

2. Test of Requirements

In this project the focus is on the impact of the child headform to the bonnet of the car. For the car to be approved, the **regulation** states that the **Head Performance Criterion (HPC**), computed by acceleration in the headform, should be **HPC ≤ 1000** for 2/3 of the bonnet test area and HPC \leq 2000 for the remaining 1/3 of test area.

The required parameters for the test setup are a 3.5 kg headform impactor with a velocity of 35 km/h and impact occurring at an angle of 50° w.r.t. the horizon.

objective due to the shape being constructed regarding aerodynamics, hence no deflections are wanted.

Redesign is restricted to the **carbon** fiber layup of the bonnet defined as a sandwich structure with a top and bottom ply and a core.

The approach of **redesign** is seen in the flowchart. By comparing the optimum and FEA simulated displacement histories, the optimum design variable values, defining the layup, are found by the minimum residual. By a parameter study the



Based on evaluation of the **residuals** the properties of the

Fixed support Fixed in X Fixed in Y



Explicit FEA simulations are carried out to evaluate the **HPC**. The structurally bearing parts made of **carbon fiber** are defined separately in ACP and combined by contacts to the **full assembly**.

From simulations of 18 required impact locations the **HPC** values are computed.



On the right, the displacement responses are shown. The residual of the redesign is reduced by 50.9% compared to the initial design

Variable	Initial	Redesign
PVC Core	0 mm	1 mm
Top angle	0°	0°
Bottom angle	0°	0°
Top ply	Woven	Woven
Bottom ply	Woven	UD
1 Conclusions		

redesign layup is found to be as in the table.



A simulation setup is constructed for analyzing collision of a standard pedestrian child headform impacting the bonnet of the Agile SCX. From this it is found that the **Agile SCX fulfills the requirements** from EC/78/2009. A

redesigned layup is chosen Model based on evaluating the

Residual decrease

displacement **residual** of different layups compared to an established **optimum**.





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