This work is part of the PhD project “A Light Weight Car Body for High-Speed Trains” at the Center for ECO² Vehicle Design at The Royal Institute of Technology (KTH) in Stockholm. The project aims are to reduce the overall structural weight of a car body for high speed trains by 30% as well as saving manufacturing costs by 10% per kilogram.

To reach the project goals, the introduction of weight efficient sandwich structures in the car body design is investigated. Some examples of large scale sandwich application in rail transportation vehicles are Bombardier’s C20 FICA operating in the Stockholm metro, the Korean Tilting Train Express, a South Korean high-speed train which is currently being developed by the Korea Railroad Research Institute, and the FRP Schindler Wagon. Some other examples of composites and sandwich structures can be found in bus and bus-like applications such as city trams and Automated People Movers (APMs). No examples are, however, found for rail vehicles traveling at speeds above 200km/h.

One reoccurring problem with composites and sandwich structures in the load carrying structure of rail vehicle carbodies is an insufficient stiffness with regard to the first vertical bending mode of the vehicle. This has lead to that several designers have chosen to keep a rather advanced under frame within the wall, roof and floor structure to reduce the maximum deflection during, for example, vertical loading conditions. To achieve the goals set up for this PhD project the under frame should be, if not completely removed, adequately reduced.

To validate the concept an accurate Finite Element Model of a rail vehicle supplied by Bombardier Transportation has been studied. This model has been simplified to allow easier and faster modifications and simulations during optimization of the design. An element-demanding area of rail vehicle modeling is accurately modeling corrugated sheets. In the model studied corrugated sheets are utilized both in the floor and the roof of the car body. The floor sheet metal alone consist of over 80 000 elements, which is close to the lower limit with regard to geometrical constraints. For this reason several orthotropic models have been studied. The accuracy of the orthotropic models is benchmarked against a large part of the corrugated floor of the car body in modal analysis and computational times are compared. The influence of the roof and floor panels of the car on the first eigen mode is also investigated.