Development and design of the chassis for a Formula Student vehicle

Graduate

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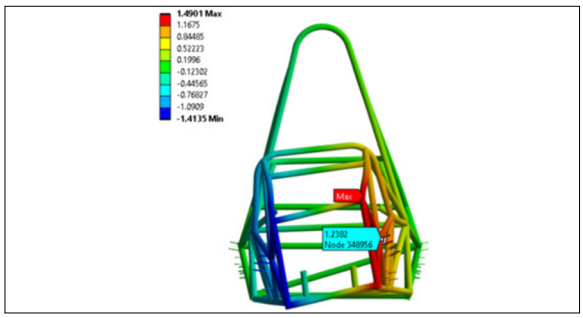
Introduction: This bachelor thesis focuses on the development and design of a chassis for a Formula Student race car. The objective was to construct a weight- and stress-optimized tubular space frame in compliance with FSAE regulations. Based on prior work, a parameterized CAD model was developed and analyzed using the Finite Element Method (FEM). Simulations covered various load cases such as braking, acceleration, and cornering. Von Mises and principal stresses were used to assess structural integrity.

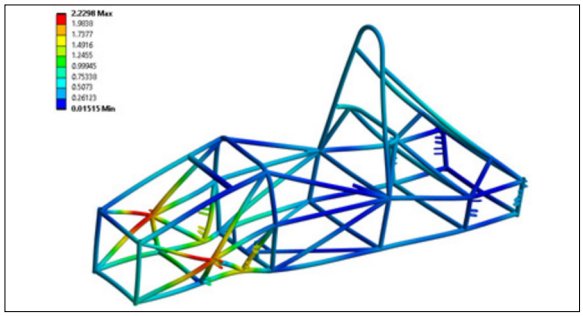
Result: The torsional stiffness was increased to 1602 Nm/° through targeted reinforcements. The figure “von Mises Equivalent Stress – Braking Load Case” illustrates the analysis of the overall model considering inertial relief. It reveals that under extreme braking conditions, significant stress peaks occur in the front axle region. As part of a subsequent optimization step, the cross-sections of the affected tubular segments were selectively increased to reduce local stress concentrations and enhance structural integrity. Submodeling was used as an illustrative approach to approximately analyze critical node areas. Although presented only briefly, it yielded plausible results and confirmed the conservative design of the shell model. Stresses were limited to the regulated value of 305 MPa. As a result, the evaluation was carried out based on the distortion energy theory according to von Mises. Weld seams were not explicitly modeled in the overall model but were approximately considered within the scope of the submodeling. A complete analysis of the weld seams was not performed.

Conclusion: The study demonstrates that shell models are well-suited for preliminary analysis and provide a solid foundation for further optimization. For future work, targeted weight reduction and a detailed investigation of the weld seams are recommended.

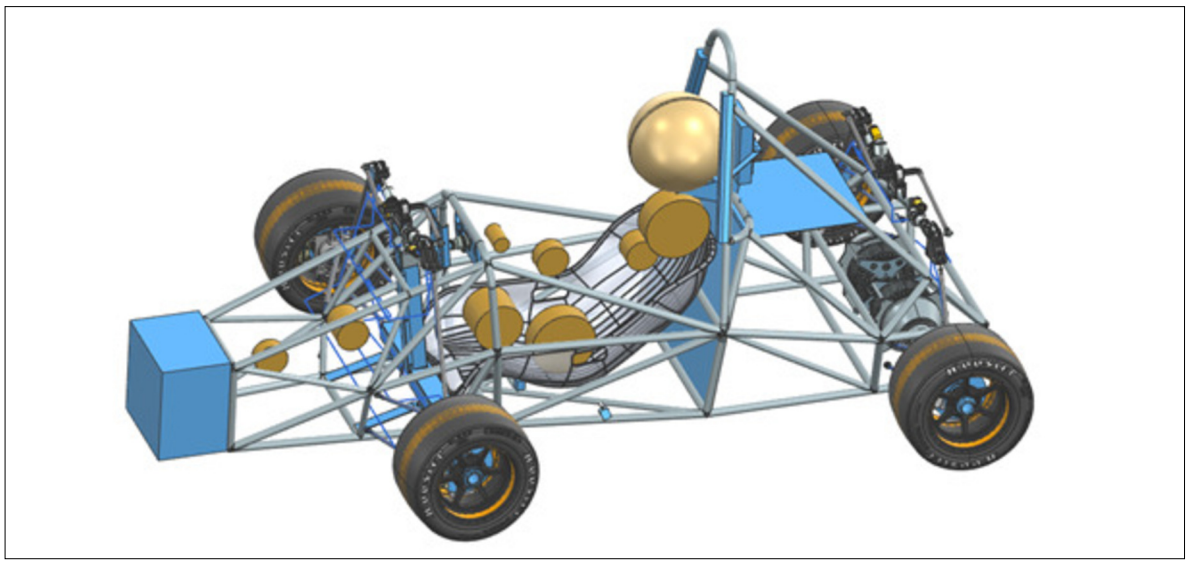
Torsional stiffness of the optimized chassis
Own presentment



von Mises Equivalent Stress Braking Load Case
Own presentment



ROST Formula Student race car concept
Own presentment



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