Innovative Computational Approaches for Enhancing Road Restraint Systems' Performance in Compliance with EN 1317 and EN 16303 Standards

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Advancements in computational modeling are reshaping the design and assessment of road restraint systems, enabling more accurate predictions of crash dynamics and structural responses. This study focuses on leveraging advanced finite element analysis (FEA) tools, particularly LS-DYNA, to evaluate the interaction between vehicles and road restraint systems under various impact scenarios. These models incorporate detailed representations of material properties, geometric nonlinearity, and elasto-plastic deformation behavior following the EN 16303 standard requirements, providing insights into the performance of both restraint systems and impacting vehicles.

Developed models were used to analyze the energy absorption capacity, deformation characteristics, and occupant safety outcomes for different road restraint systems configurations in the range from N2 to H4b containment levels. Particular attention was given to optimizing the stiffness and resilience of critical components, such as guardrails ad spacers, to enhance crash energy management. The computational framework integrates parametric studies run on supercomputer to assess the influence of vehicle type, impact angle, and velocity, ensuring compliance with EN 1317 standards for containment and redirection.

By refining these advanced computational models, the study identifies design enhancements that mitigate impact severity while maintaining structural integrity of road restraint systems. This approach offers a robust methodology for testing and validating road restraint systems, reducing the reliance on costly physical experiments. The findings demonstrate the critical role of computational simulation in advancing road safety technologies and supporting the development of regulatory standards.

This research highlights the potential of computational innovations in combination with supercomputing to transform the design of road safety systems, fostering safer road environments for diverse traffic conditions. The integration of these models into the design process represents a significant step toward improving road safety outcomes through science-driven engineering solutions.