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A Report on Lightweight Materials and Structures

Kambiz Lee*

Department of Architecture, University of Strathclyde, UK

Description

Every contribution that resulted from this event has been meticulously revised and elevated to the calibre of standard journal publications. As a result, they successfully completed Materials and Design's customary, meticulous peer review procedure, which in this instance was co-moderated by the guest editors-the writers of the present introduction. Since there are no proceedings in the Euromat series, none of the contributions have ever been published in conjunction with a conference before. Weight reduction is a constant concern in transportation applications, hence research in this industry has focused on lightweight materials, structures, and related processes. Additionally, they cannot be separated because the method used to transform materials into engineering structures would inevitably alter their physical characteristics. It is well known that choosing a material and manufacturing process has a significant impact on a component's cost and that this decision is made early in the design process.

Consequently, when thinking about introducing new materials. , design engineers must be aware of the effect of both materials and processing on performance, manufacturability and cost. Lightweight design, which according to a much-cited statement aims to place the right material in the right place, is centered on exploiting material properties to the limit. Margins are becoming smaller here, and thus besides extending knowledge on materials and processes, a parallel development of modelling, simulation and optimization methodologies and tools becomes a necessity of similar importance. Hence, Materials and Design, which aims at linking the design and materials engineering communities, is a natural haven for a special issue on this topic. The editorial in question does not purport to discuss all means of transportation in detail. Since there are many obstacles that lightweight materials and structures must overcome, we have chosen to concentrate our opening remarks on advancements in the automobile industry. Furthermore, we want to highlight that changing boundary conditions and fundamental technological approaches require continued efforts in research and development to secure what has been achieved and facilitate further progress. The phrase "weight spiral" is often used to refer to the automobile industry's efforts to control generation-to-generation vehicle weight growth despite safety regulations and consumer expectations for more comfort and functionality.

When comparing successive generations of different car models using metrics other than just vehicle weight, the actual successes of these initiatives may be shown. The so-called "Leichtbaugüte," or freely translated, lightweight design quality factor, is one idea in this regard that takes into account simultaneous patterns like size increase and performance enhancement. Usually, the weight of the body-in-white (BIW) is determined by multiplying it by the product of the static torsional stiffness and the footprint, which are determined by the wheelbase and track. Such developments are enabling design engineers to actually profit from the many lessons already learned in lightweight design: whereas improvements in this field have been mandatory to open up some freedom of design in the past, they now lead to an actual weight reduction.

And this reduction can trigger the same secondary effects that formerly made halting the upward trend so difficult. Individual challenges for lightweight design exist in other transport modes. In the aerospace industry, the current transition from metal to carbon fibre reinforced plastic (CFRP) structures has opened up many research issues. Besides the general need for even deeper understanding of material performance e.g. in terms of fatigue, topics like process improvement for higher yield or lower cost as well as the realization of hybrid joints and structures that link FRP to metal on material and structural level can be named. Specifically in these areas, borders between transport industry sectors may easily be crossed, and the special need of lightening FEVs may serve as catalyst. This is exemplified e.g. by the large-scale introduction of CFRP structures in BMW's i3 full electric vehicle – the first introduction of CFRP as primary body material in a car of this production volume class. Still somewhat unique to aerospace structures is the topic of sensor and electronics integration for realizing structural health monitoring of self-sensing structures The link to lightweight design is via a reduction of safety factors in return for the permanent awareness of structural state provided by the system. The use of materials in transportation constructions is in many ways related to modelling, simulation, and optimization of materials and structures [1-5].

Conclusion

For the introduction of novel materials in product design, it is necessary that appropriate material models and modelling techniques exist. In order to enable techniques like robust optimization and virtual testing, such models and the associated simulation and optimization techniques and tools are increasingly required to include stochastic processes. At the same time, basic simulation approaches, such as ab initio methods, are being employed more and more to adapt material properties over many length scales to particular application requirements.

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Conflict of Interest

The Author declares there is no conflict of interest associated with this manuscript.

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***Address for Correspondence:** Kambiz Lee, Department of Architecture, University of Strathclyde, UK, E-mail: leekam67@edu.in*

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