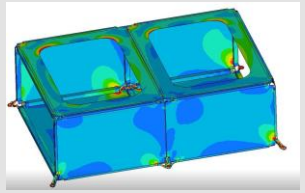
LIGHTWEIGHT SOLUTIONS

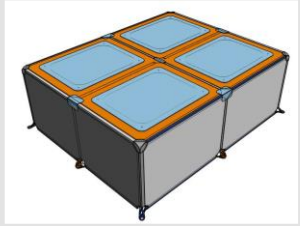
Short introduction: TGM GmbH

Our portfolio is based on three main pillars

Lightweight expertise

Construction and Calculation

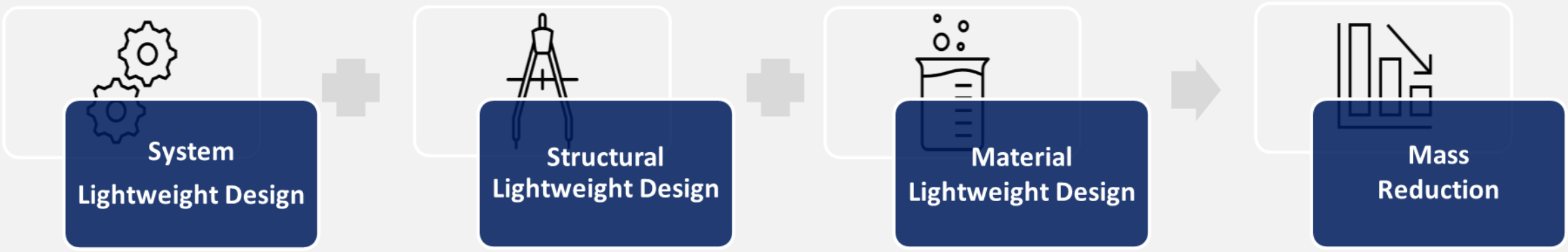




TGM Academy

Short introduction: Lightweight expertise

TGM offers holistic lightweight engineering in the context of concept development and optimization of components, structures or complete systems in the automotive, rail vehicle, shipbuilding, and aerospace industries.



TGM – Way of Working

Analysis	Preparation	Innovation
Inspection of Data (CAD, boundary conditions, etc.)	Establishment of a central table (weight book) for weight control/forecast	Holistic Screening for weight saving opportunities
Analysis of weight breakdowns		Holistic Analysis of weight saving opportunities
Prioritization of components according to customer specifications and possibility of influence for weight optimization regarding time and cost budgets		Creation of decision sheets (one-pager) for estimates **Optional:** Simulation und Structural optimization
Simultaneously: Project Management Support		

TGM References

Project references: Automotive

BMW
- Vehicle weight optimization during early development phase Generation of fundamental weight saving opportunities
- Structure & system lightweight design

LAMBORGHINI
- Super sports car early development phase
- Target weight evaluation & derivation
- FEM based topology optimization
- Special structure & system lightweight design for meeting performance targets

VOLKSWAGEN
- MEB platform weight optimization
- Vehicle projects for Chinese market
- Research project next generation lightweight cars
- Overall structural lightweight design

PORSCHE
- Weight workshops regarding process optimization
- Vehicle weight management

DAIMLER
- Overall vehicle weight management
- Weight reduction during whole development process




Project references: Rail

SIEMENS
- Holistic Lightweight consulting
- Weight management Support
- High speed trains/railcars/trams/metro/light rail vehicles
- ICE4, AVENIO, HF6, S200 MUNI (USA)

ALSTOM/ BOMBARDIER
- Holistic Lightweight consulting
- WDT based weight management Support
- High speed trains/railcars/double-deck-cars/trams
- DO2010 / TWINDEX
- ZEFIRO Highspeed / LRV Flexity Outlook

SKODA
- Holistic Lightweight consulting
- WDT based weight management support
- ForCity Smart

STADLER
- Holistic Lightweight consulting
- WDT based weight management support
- Successful weight reduction & axle load optimisation
- METRO JK (Berlin) / Double Deck vehicle “Rocky Mountaineer”

Other Projects:
- DEUTSCHE BAHN, HARSCO, PESA, HÖRMANN

Project references: Aviation and Aerospace

AIRBUS

- Aircraft future projects - weight management
- Early development phase
- Responsibility for overall Aircraft– A30X (wings, fuselage, interior, empennage and turbines)
- Aircraft A380 cabin weight optimization
- Use of TGM´s Smart Act to steer mass properties

MT AEROSPACE

- Lightweighting consultancy & process optimization
- Development of a “Mass properties & Lightweight Control & Weight management system” for space systems in early and later development stages

Other Projects:

- BOEING, GE AIRCRAFT

Project references: Shipbuilding

Wallaby Boats

- Weight analysis and optimization of a deckhouse
- FEM verification calculations

MariLightCluster

- Member of the maritime lightweight network MariLightCluster of the *Center of Maritime Technologies gGmbH*

Further projects in preparation

Thank you for your attention

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Backup

Holistic Screening for weight saving opportunities

- Holistic weight saving opportunities are quickly captured and clustered without analyzing the potential levels in detail

- All primary disciplines can be included
(Whole vehicle, vehicle body, interior equipment, drive system, air conditioning, doors, etc.)
- TGM uses special methods and experience from previous projects for this purpose:

    - System Lightweight Design (functional analysis and integration, system interfaces, effective areas, primary and secondary mass effects in system space and via interface effects),
    - Structural Lightweight Design (load paths, neutral axes, shape stiffnesses, differential and integral load-bearing systems, sandwich systems, shear field load-bearing systems) as well as the use of
    - Material Lightweight Design and technology screening (stress-appropriate material selection, latest available technologies from suppliers).

- Presentation/ discussion and prioritization of the identified potentials together with the customer (weight groups, development areas, project management) and mutual determination of the weight saving potentials to be further pursued and analyzed according to prioritization.

- If necessary, preparation and presentation of decision documents for the project management.

Holistic Analysis of weight saving opportunities

- Analysis and illustration (through one-pager) of existing prioritized weight saving potentials incl. estimation of potential level and iterative increase of potential maturity level by using
    - Analytical methods in the field of **system and structure evaluation**
    - If necessary, **concept sketches** (in 3D CAD) for some weight saving opportunities within the system space including interfaces can be drawn
    - **Simplified FEM-based verification** of weight saving opportunities based on concept sketches, if necessary.
    - Optional **topology and topography optimizations** for selected assemblies
- Continuous recording of the weight saving opportunities and risks in the weight book and preparation of forecasts for the target approach, determination of the ranges of assembly masses and vehicle empty mass, axle loads and wheel loads using the prioritized opportunities.
- Optional: Innovation workshops with weight group, all development areas, the project management and possible suppliers to discuss and present the developed weight saving opportunities as well as the expected risks.

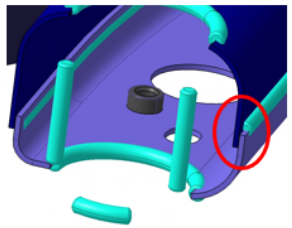
Example: TGM One-Pager

LEICHTBAU UND GEWICHT

Ideen-Nr.:

Ist-Stand | **Modul**

Bild



Beschreibung

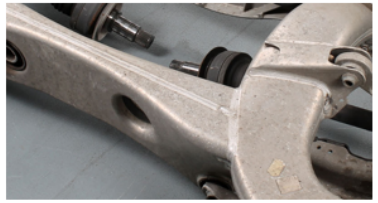
- *Aktuell werden Ober- und Unterschalen ineinander gesteckt und anschließend verschweißt.*

Auswirkung für Endkunden bei Änderung

- *Keine*
- *Bauteil nicht im Sichtbereich*
- *Keine Komfort-/ Fahrdynamikeinschränkungen zu erwarten*

Idee und Deltabetrachtung:

Bild



Beschreibung

- *Durch den Einsatz anderer Fertigungsverfahren (Schweißen in Formen, Laserbeschnitt) können Ober- und Unterschale mittels Stumpfstoß gefügt werden*
- *Potential **300g***

Ersteinsatz/ Absicherung

- *Hinterachsträger Mercedes-Benz W221, u.A.*

Gewicht/ Betriebswirtschaft

Delta Gewicht in kg:	0,3 kg
Delta HK	-
€/kg	10
E-Kosten	-
SBM	-

Bewertung

- funktionale Bewertung
- terminliche Bewertung
- technolog. Bewertung
- betriebsw. Bewertung

Kommentar

Erfordert Schweißen in formgebender Vorrichtung

Verantwortlich

Datum

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