

Lightweight Forging

Intelligent Lightweight Design through Multi-component Processes

Motivation

The continuous pressure in the automotive industry to reduce a car's weight, forces the engineers to look for new areas to apply lightweight design to. Therefore, power train, chassis and with them the gear box are being focused on now. Gear wheels within the gear box are solid components. In future, differential design will save weight here.

Approach

We search for possibilities for lightweight design along the gear wheels whole process chain, beginning with design, going over to production and ending with the final product. Afterwards, gear wheels in differential design are proposed (figure 1 and 2). Numerical investigations focus on combinations of different designs, materials and manufacturing techniques to detect and understand interdependencies. Subsequently to the numerical investigations, prototypes are manufactured and tested.

At *utg* we manufacture wheel bodies only and look into the manufacturing techniques deep drawing and fine blanking. These manufacturing techniques are already taken into account during design phase. Manufacturing of gear ring and joining it with the wheel body is conducted at our partner institute IWT in Bremen. Finally, there will be endurance trials at another partner institute, the FZG in Munich, to ensure the durability of the designed gear wheel.

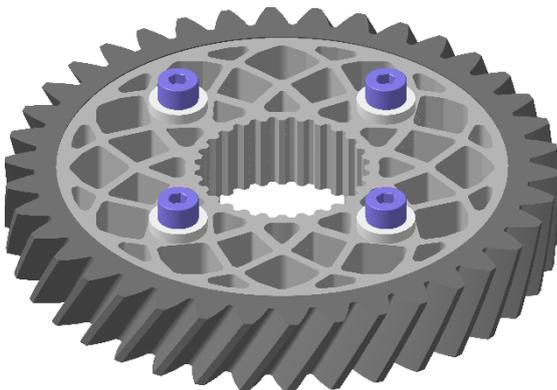


Figure 1: Multi-component gear wheel, consisting of gear ring (dark-grey) and wheel body (light grey) with stapled sheet metal wheel body. The single sheet metal layers are fine blanked at *utg*, Munich. Gear ring and wheel body are joined immediately after the gear rings heat treatment at IWT, Bremen. Connectors hold the sheet metal layers in place during transport. They will be removed for the endurance trials. In mass production, the sheet metal layers will be connected via stacking after cutting.

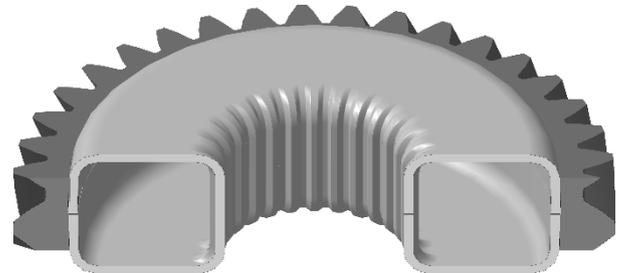


Figure 1: Multi-component gear wheel (sectional view) with deep drawn wheel body, which is divided horizontally and therefore consists of two separate parts.

Results

Until now we manufactured a gear wheel with stapled sheet metal wheel body successfully (figure 3). First deep-drawn wheel bodies have been produced as well. As soon as gear wheels with both types of wheel bodies exist, we will conduct static tests to investigate the force needed to push the wheel body out of the gear ring in axial direction and how much torque the gear wheels can transmit.



Figure 2: Multi-component gear wheel with stapled sheet metal wheel body.

Conclusion

Within the research project Lightweight Forging we developed and manufactured promising designs for lightweight design gear wheels. Weight savings of 35% (189 g) with the stapled sheet metal wheel body have been achieved. The numerical investigations predict the load capacities of the new gear wheel designs and a solid gear wheel to be on the same level, which would allow to replace the solid gear wheel with one of the new designs.