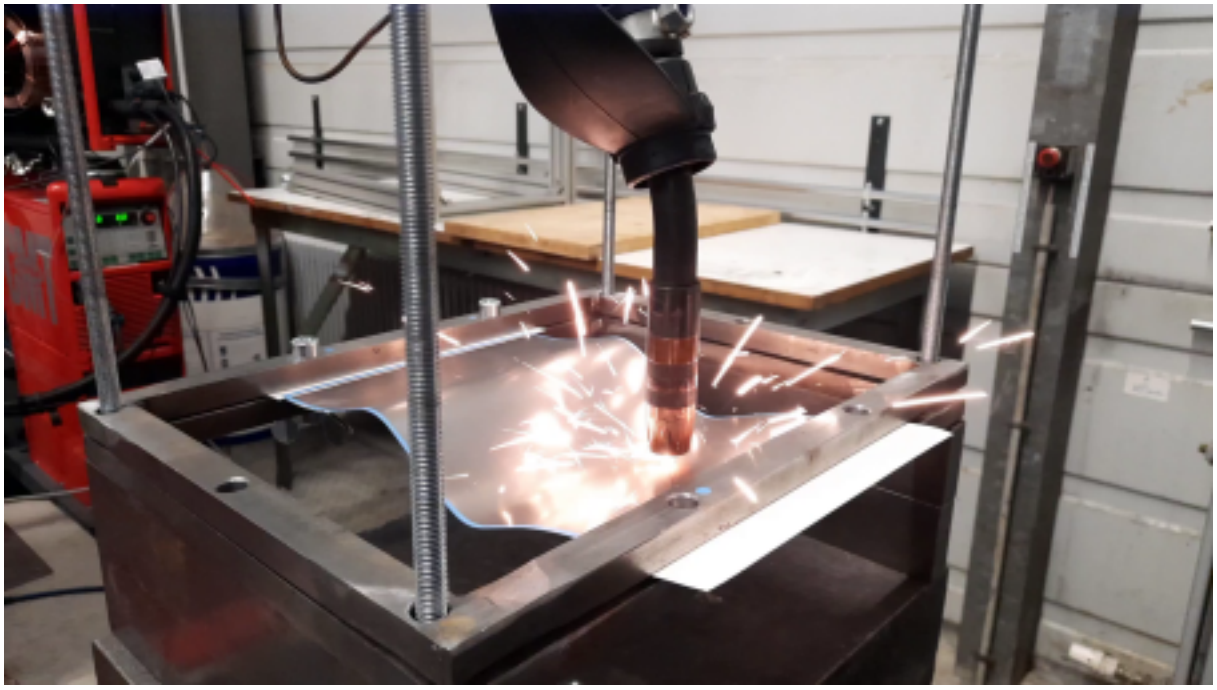
Automated production of free-form sheets: Additive processes reduce material consumption

About this project



FORMlight

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Markets:

Material: Steel

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Technology Transfer Program Leichtbau

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Context

Free-form sheets are indispensable for iconic architectural projects such as the Chrysler Building or the Morpheus Hotel. However, their production is complex: They are usually created using expensive manual labour, as existing processes such as incremental sheet metal forming or multiple-point stretch forming are technically too complex and cost-intensive. Alternatives such as shingles or composite materials require compromises in terms of design and are often difficult to recycle.

At the same time, there is a lack of industrial processes for producing free-form sheets efficiently and in a resource-saving manner. This gap exists despite the increasing demand for lightweight, free-form façade elements that meet high sustainability standards.

Purpose

The aim of the FORMlight research project is to develop a manufacturing technology that can be used to produce lightweight, rigid, material-pure and recyclable thin sheets for façade construction to replace thick sheets or composite materials such as Alucobond.
By using Wire Arc Additive Manufacturing (WAAM), an additive manufacturing technology in which welding material is melted using an electric arc as a heat source and applied in layers, both flat thin sheets and elastically deformed thin sheets are to be locally stiffened and frozen in shape by welding on ribs.

This procedure saves material, reduces the weight of the façade elements and should enable the economical production of free-form façade sheets for construction for the first time. In addition to ecological benefits such as CO# savings and complete recyclability, the FORMlight project aims to create new architectural freedom and revolutionise the construction of free-form façades.

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Procedure

The project team is developing various methods for the digital 3D reconstruction of the reflective metal surface of deformed metal sheets. To do this, the team optically records the deformation of the sheet metal and then converts it into a digital model.

In order to be able to apply the reinforcing ribs to the thin sheets using Wire Arc Additive Manufacturing (WAAM), the team determines the permissible process window experimentally and works on techniques for predicting the optimum arrangement of reinforcing ribs. These prediction techniques are important because the optimum arrangement of the reinforcing ribs depends, for example, on the sheet size, the number of ribs, the sheet deformation and the joint and crossing points of the welding ribs.

In order to derive the required free-form geometries more efficiently from the façade planning, the project team programmed a software tool so that the design of the sheet metal geometries no longer has to be done manually but can be automated. Finally, the team produces a demonstrator from moulded sheet metal with different rib arrangements, which is suitable for presenting the promising technology at trade fairs.

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About this project

Funding duration:

Funding sign:	03LB3048	**Funding amount:**	EUR 674 thousand

Final report

Further websites foerderportal.bund.de/foekat/jsp/SucheAction.do?actionMode=view&fkz=03LB3048A - FORMlight in the federal funding catalogue

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Project coordination

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Lightweighting classification

	Realisation
Offer	
Products Parts and components, Software & databases, Systems and end products	✓
Services & consulting Technology transfer	✓

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Lightweighting classification

	Realisation
Field of technology	
Design & layout Lightweight manufacturing	✓
Functional integration Sensor technology	✓
Measuring and testing technology	
Modelling and simulation Loads & stress, Optimisation, Structural mechanics	✓
Plant construction & automation Robotics	✓
Recycling technologies	
Manufacturing process	
Additive manufacturing 3D printing, Deposition welding	✓
Coating (surface engineering) Galvanising	✓
Fibre composite technology	
Forming	
Joining Welding	✓
Material property alteration	
Primary forming	
Processing and separating	
Textile technology	

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Lightweighting classification

	Realisation
Material	
Biogenic materials	
Cellular materials (foam materials)	
Composites	
Fibres	
Functional materials	
Metals Steel	✓
Plastics	
Structural ceramics	
(Technical) textiles	