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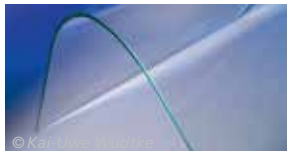
Design and function elements in flat glass sheets.

Application examples

With the test systems of our research center and the simulation tools we have developed, we support our clients in establishing complex bending processes and in process optimization, particularly for the shortening of processes, quality improvements and cost reductions. We also devise solutions for realizing shape diversity and provide proofs of concept.

Manufacturing processes, product examples

- Processes with and without a mold and the use of adjustable molds
- Processes involving heat and force applied locally
- Processes for small batches and variable geometries
- Processes for glass parts with particular requirements (e.g. surface quality, contour accuracy)
- Glass products for architectural use (e.g. curved panes for insulated glazing in building facades)
- Technical products (e.g. curved solar modules, instruments with built-in displays)
- Design products



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The Fraunhofer IWM is the point of contact for industry and public contracting bodies concerning component and systems reliability, safety, durability and functionality. The Fraunhofer IWM's "mechanics of materials" services focus on identifying weaknesses and defects in materials and components, determining their causes and building upon this to realize solutions – including material development, manufacturing processes and testing procedures – that lead to the efficient and reliable use of components.

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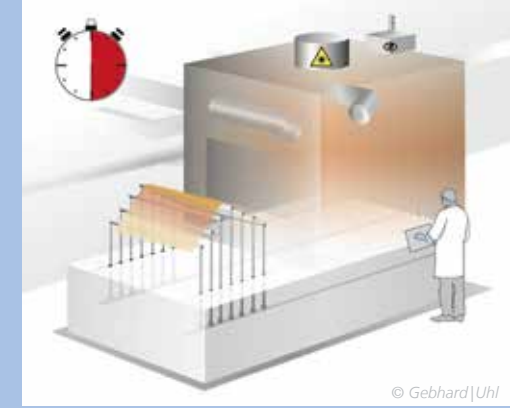
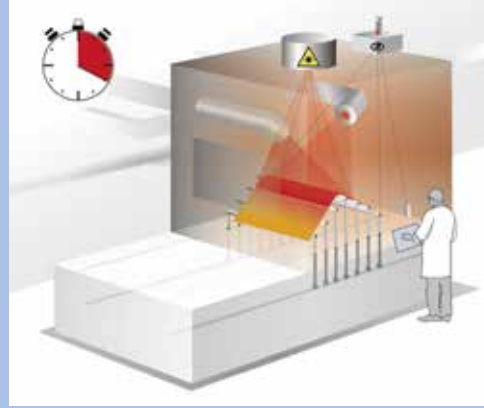
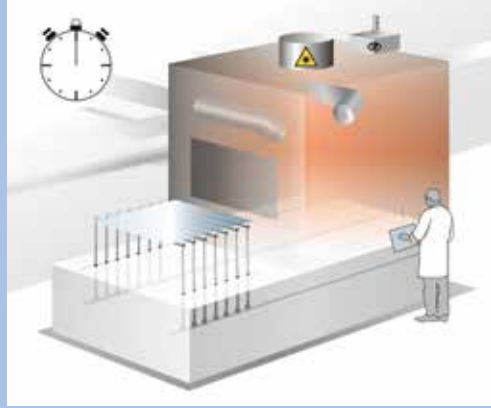
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BENDING OF FLAT GLASS



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Economic manufacturing processes for bended flat glass products

Since smartphones became widely used, the material glass has grown in popularity and use in new products. New manufacturing processes together with the requirements of designers and users have resulted in specially shaped glass components finding increasing levels of application.

The effort and costs involved in producing three-dimensionally shaped glass parts depend primarily on the geometry and the requirements for geometric precision, surface quality and batch size. Only where batches are very large investments in expensive shapes are worthwhile. Where smaller batches are to be produced, with rapid changeover between different product geometries, there is a need for an economically viable process engineering solution. This is where research at the Fraunhofer IWM comes in.

The Fraunhofer IWM offers solutions for shaping glass in three dimensions, rapidly, without any costly mold construction.

Unique, industry-oriented research unit for testing and evaluating bending processes

The Fraunhofer IWM offers an industrial glass bending unit for glass dimensions of up to 1 m² with extensive manufacturing and measurement equipment. Depending on the type of application, different techniques are used to apply bending forces and to heat the glass.

Facilities

- Adjustable, follow-upbending tool
- Local heating of glass sheets with various heat sources (hot air, laser)
- High-power CO₂ laser with beam guidance via scanner system
- 2-dimensional online measurement of glass temperature
- High automation potential with central process control and reproducible process sequences
- Research system offers possibility of customer-specified modifications

We develop industrial processes by means of simulation methods and laboratory experiments

In addition to the conventional experimental approach, we use simulation models to investigate interactions and the influence of process parameters. In the numerical models, material properties are taken into account in order to derive process sequences. In the time-related development, thermal fields and material deformations are calculated. An example for the use of simulation results can be seen in the following illustration. Here the temperature development at a laser-irradiated ring and the vertical displacement at the center of the circle are simulated through the effect of gravity.

