SHAPE 3
Informations about 3D-Textiles
InForm!
September 2006

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A word of welcome

Dear Reader,

in hand you have the first issue of the newsletter published by Shape 3 GmbH in Wuppertal, Germany - an innovative company that will keep you informed about the current state of research in the field of 3D textiles.

Among other things, this first issue of "Shape 3 InForm" deals with the subject of "individuality". By using simulation software, 3D preforms can meanwhile be designed in a way that all the individual requirements of the final composite part are fulfilled. Since 2003 the *Niederrhein University of Applied Sciences* has been working on a CAD-based simulation software for 3D woven fabrics. Before long it will be possible to forecast the mechanical properties of 3D reinforced parts.

We invite you to join the technical discourse with the Shape 3 team or to develop and realise concepts for mutual projects.

We look forward to entering into a dialogue with you.

Best regards

A. Bücker

Individualisation with CAD

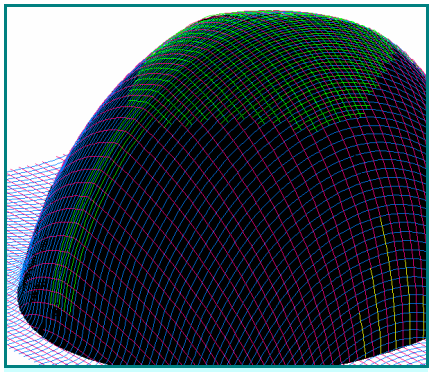
Simulation of 3D-Woven Fabrics

By using CAD simulation software, the fibre reinforcement of a composite part can be adjusted very accurately to the required properties. It is implemented with Shape Weaving Technology, producing 3D preforms which can be processed easily and fast into composite parts.

The simulation was developed during a research project carried out by the *Niederrhein University of Applied Sciences* in cooperation with Shape 3 GmbH (Wuppertal), which was supported by the federal state of North Rhine-Westphalia. The intention of the project was mainly to substitute the necessary but very time-consuming weaving trials during the development process of 3D preforms by CAD simulation.

In practice this new Design software has already proved to be of great value. The first step is for the design engineer to collect the geometric data of the part using established standard formats such as *.dxf and edit the data with Mechanical Desktop, if necessary. Then the new 3D fabric simulation is activated. The engineer inserts the warp and weft threads at locally varying intervals, so that the fibres are concentrated in those places where the composite part will subsequently be under load. In addition, particularly stressed areas can be reinforced with additional threads. The coordination of both methods even allows to influence the orientation of the threads on the 3D surface.

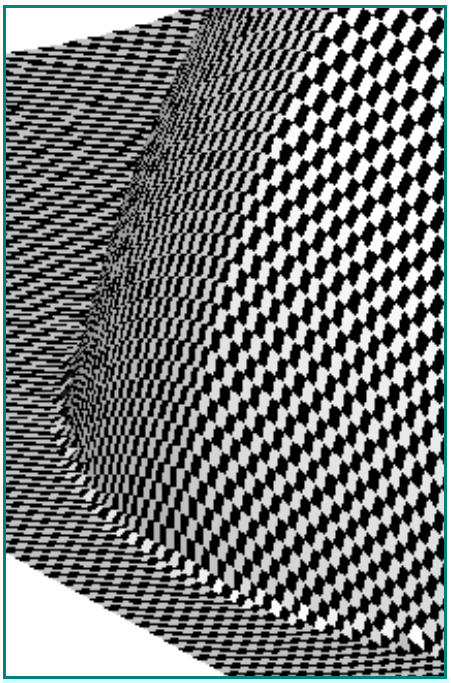
With the simulation the orientation and angles of the threads can be adjusted more easily resulting in high-quality surfaces.



Additional threads are used to reinforce a 3D woven helmet shape in defined areas

The second step deals with the use of suitable weaves, which can be adjusted to the requirements of the composite part. For instance, in some areas an increased resistance to the flow force of a matrix is necessary, whereas in other areas it is more likely that loose threads are required to subsequently insert inlays. By using the simulation software the design engineer is able to adjust the weaves indi-

(to be continued on page 2)



3D point papers allow an accurate adjustment of the weave of the three dimensional surfaces.

(continuation of page 1)

vidually and edit each interlacing point of the fabric on 3D point paper.

Such individualised preforms are manufactured on a special 3D weaving machine using Shape Weaving Technology. In practice, a very good correlation of simulation and 3D woven fabric regarding the shape and the orientation of threads is achieved.

A new research project is dealing with the forecast of the mechanical properties of composite parts reinforced with 3D woven preforms. We will inform you about first results in one of the next issues of Shape 3 InForm.

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R&D on Serial Production

The serial production of fibre reinforced composite parts of reproducible quality is still a challenge.

During an AiF-project (supported by the German government) an overall concept for the serial production of 3D fibre reinforced lightweight composite parts is to be developed, at the same time taking advantage of the benefits resulting from the use of seamless woven 3D preforms.

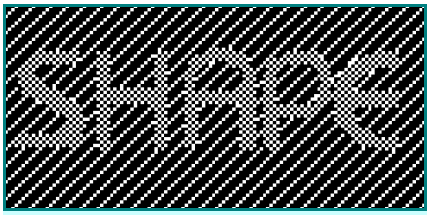
Partner of this R&D project is the „Institut für Konstruktion und Verbunbauweisen“ (KVB) in Chemnitz, Germany.

Fixing device

Logos in Woven Fabrics

For users from different application areas the possibility to individualise Carbon composite parts is of great interest. The programmable weave design of a Jacquard machine provides ideal opportunities. Using this technique to create a high-quality and individual surface design for fibre reinforced composite parts, will enable you to stand out from your competitors.

Individual logos, pictures or symbols, as part of the user's Corporate Identity, can be inserted directly into the fabric and thereby into the surface that is to be varnished. Furthermore, individual patterns can be realised in the whole fabric, creating attractive new visual effects.



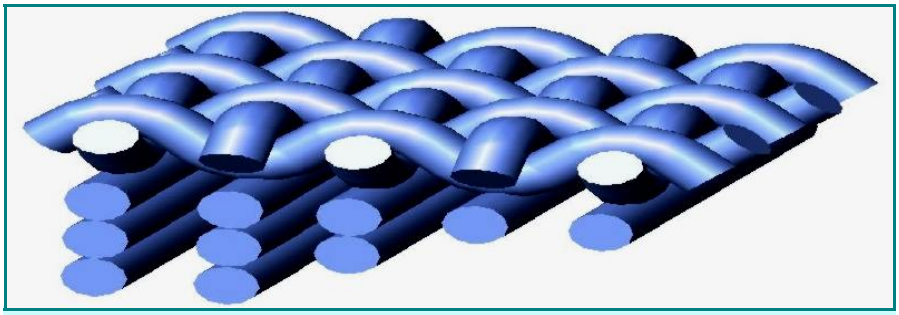
Jacquard weaves for a woven Logo, e.g.: letters = plain weave 1/1 backround = twill 7/1 z

The visual appearance of the carbon fabric is influenced by different factors, as for instance the yarn count. A low yarn count results in a higher resolution of the logo or picture (comparable to the screen resolution of a PC monitor). The effects also depend on the adjustment of the different weaves used. Only a combination of excellently adjusted weaves will create the requested effects. The drawing shows a logo with only two colours realised by using two different weaves. In more complex pictures or logos with a multitude of colours, a lot more weaves have to be adjusted. Similar to damask fabrics not more than four to five patterns should be used in a single colour Carbon fabric.

In addition, these individual surfaces can be shaped into the third dimension using the Shape Weaving technology.

Pre-taylored multi-layer Fabrics

Creating structures that meet the demands



Multi-layered woven fabric with varying wall thickness and varying 0°-fiber volumes

Often several layers of Carbon fabric are needed for the construction (laminating) of fibre reinforced composite parts to guarantee adequate strength. However, this method is very time-consuming and the different layers are not interconnected.

With the construction of an individually designed multi-layer structure the separate Carbon layers can be partially woven together. Consequently they are protected against displacement, resulting in better stability of the whole structure.

The single layers can be made up of different types of woven fabric. To guarantee a good visual surface for instance, a plain fabric made of a 400 tex material could be chosen for the upper layer.

The lower layers could be – as shown in the sample –monoaxial woven fabrics. Fibres of a different count or even different fibres can also be woven in to reinforce the fabric in axial direction. The described multi-layer fabric can be used in a bearing arm, for instance. The picture on the left schematically shows the layer construction described above.

The number of layers of the fabric is influenced by the size of the jacquard. As the warp- and weft threads can be individually controlled, the multi-layer fabrics of Shape 3 can be also manufactured with partial increased wall thickness.

Publications on 3D-Textiles

Workshop: Innovative textile materials for interiors
ICPT Conference
„Smart interior surfaces and materials“,
Munich, Germany 2 June 2006

Prof. Dr. A. Büsgen:
New Prospects in Airbag Production
32 nd Textile Conference Aachen Germany
23/24 November 2005

Prof. Dr. A. Büsgen:
Production and Application of Three-dimensional woven Fabrics
Textile days Innsbruck,
Institute for Experimental Architecture,
Innsbruck, Austria, 29 May 2006

Prof. Dr. A. Büsgen:
Possibilities for the Production of woven 3D-Geometries
Symposium „3D Textiles“
Haus der Wirtschaft,
Stuttgart, Germany
20 June 2006

Karlheinz Mutz
Future Textiles in the Third Dimension
DNZ fashion industry international
issue 04/2006
page 56-57

Prof. Dr. A. Büsgen,
Prof. Dr. K. Finsterbusch,
Dipl-Ing. (FH) A. Birghan
Simulation of Composite Properties Reinforced by 3D Shaped Woven Fabrics
12 th European Conference on Composite Materials (ECCM)
Biarritz, France,
29 August – 1 September 2006

3 Versions of 3D Fabrics

3D woven shells

Open shells in the shape of the composite part, seamlessly woven using Shape Weaving technology

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3D woven tubes

Tubular-like shapes that may contain tapering and/or branching

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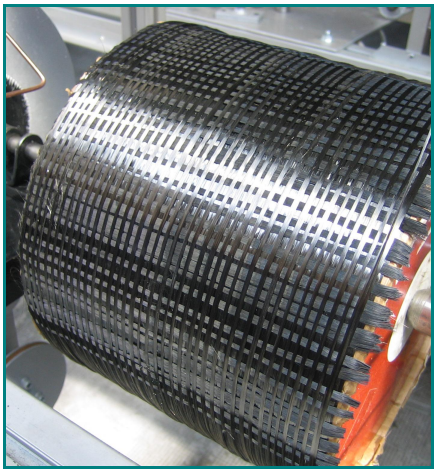

Orthogonal 3D cylinders or cones

Thick-walled cylinder or cones with arbitrary fiber orientation (e. g. x-y-z orientation)

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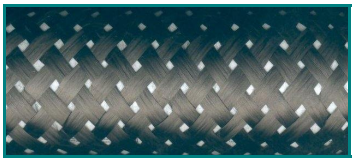
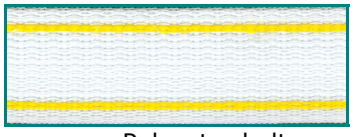
Technical Ribbons and Braids

Individual Development of 2D-Textiles

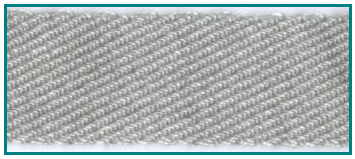


48 circular braided fabric made of 12K Carbon yarn



Polyester belt with reflective bands

Fireproof Nomex-Cord



Sensor ribbon

Website of ribbons and braids: www.buesgen.com
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