Technology/Process: **3D-Weaving**

Responsible: **Fredrik Winberg**

Partners: **Biteam AB**

Work package: **3.3 – "3d Textiles"**

GRÖN FLYGTEKNISK DEMONSTRATION

Description of Technology/Process:

Fiber to profiled beams, such as triangular cross-sectional noodles, are directly producible in one step by weaving the warp yarns with vertical wefts and horizontal wefts. The produced preforms are fully integrated.
The directly produced 3D fabric in noodle shape has fibers in 0°/90°/90° (warp/ vertical weft/ horizontal weft) orientations and resists delamination.
A weaving machine incorporating the novel dual-directional shedding operation has been designed and developed.

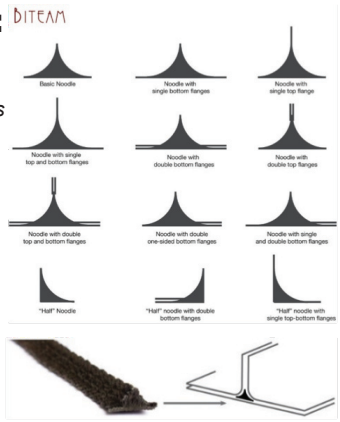
Before:

Biteam's patented 3D-weaving technology is an advancement not seen in over 27000 years of weaving history. It has nothing in common to known methods. Designed for composites application, its TRL was 4 at the start of this project.

With the new machine's development, its TRL rises to 5.

Illustration:

Carbon fiber noodles of different shapes, sizes and constructions are directly producible.



Keywords:

3D-Weaving,
Dual-directional Shedding,
3D Fabrics,
Profiled Preforms,
Beams,
Composites

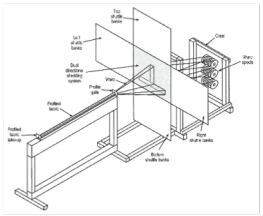
Benefits:

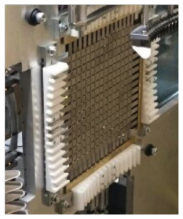
The direct production of noodles by Biteam's 3D-weaving process eliminates:
Cutting, stacking, and forming fabrics to generate shape.
Inconsistent quality and contamination risks.
Material wastage and associated negative impact on environment.
The process provides:
Customized shapes and dimensions for faster composite production.
Savings in labour and inventory.
Short development times and cost-effective preforms.

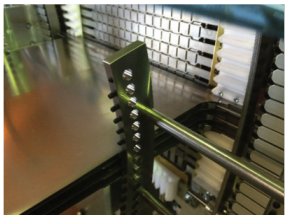
Work performed:

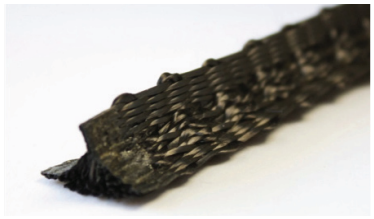
The newly developed 3D-weaving machine, with its unique dual-directional shedding system, uses warp tows supplied in a grid- like arrangement. Warp tows are arranged in a maximum of 15 columns x 15 rows and directly supplied as per the required shape and size of noodle's cross-section. The wefts are supplied in required number of vertical and horizontal shuttles.
The evolving machine is operable by selecting suitable programmes and is flexible for both batch and continuous productions. Designed for producing a variety of noodles using carbon fibre tows (1k – 12k), the maximum noodle cross-section producible is about 50x50 mm. The noodles are presently producible in straight lengths of 2 m. The production rate of the complex noodle cross-section is about 0,5 - 1 m/h, with a spacing between vertical and horizontal wefts (6k) of about 4 mm.
Noodles of different fabric architectures were produced semi-manually in a trial setup and supplied for tests. The test results indicate easy handling, no delamination, low variation in test results and good mechanical performance of joints/ intersections of composite structures.

The possibility of directly producing different cross-sections simplifies setting-up. Its gentle treatment of fibres improves product quality. The relatively quieter weaving operations contribute to a healthier working environment. Its compact design requires relatively low floor area. It works pneumatically to eliminate the risk of electrical short-circuiting by carbon fibres.









Future developments & exploitation:

The newness of the technology and materials present a large unexplored field. Cross-sectional shapes such as I, Pi and Box beams shall be produced using the developed equipment. Different fabric architectures shall be engineered for optimizing material performance. A higher automation of the process will improve the productivity and lower the costs. Certain new ideas developed and incorporated in the new machine will be patented. As noodles and other profiled beams are required in many composite constructions, making them available commercially will be a priority alongside further improving the machine's TRL.